CANADA
DEPARTMENT OF MINES AND RESOURCES

MINES AND GEOLOGY BRANCH

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BULLETIN No. 104

BIOLOGICAL SERIES No. 32

BOTANY OF THE CANADIAN EASTERN ARCTIC

PART III

VEGETATION AND ECOLOGY

BY

Nicholas Polunin

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.Ph.,
KING'S PRINTER AND CONTROLLER OF STATIONERY
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FOREWORD

This work was completed in the first year of the second world war and revised during the winter of 1941-42. As with Part II, publication was delayed until after the cessation of hostilities, when it was promptly authorized by the Canadian Government. Conditions in England were then still not all that might have been desired, and no detailed revision was possible. Nor indeed was this deemed necessary, as to the best of my knowledge since the beginning of the war no serious paper has been prepared on the vegetation or ecology of the "Eastern Arctic" area, no further extensive plant biological work has been accomplished in it (apart from my own of 1946, some general results from which are incorporated in this volume), and no noteworthy change has taken place in our general conception of arctic vegetation or plant ecology. Nevertheless, it should be remembered that the basic writing was done some years ago, often under trying circumstances, and without cognizance of many of the most recent contributions to arctic phytology that seem to be pouring in from the continent of Europe and elsewhere now that the war is over.

With the preclusion of complete revision for publication, no attempt has been made to add all the latest references or superimpose new ideas. But some necessary minor alterations have been made (as well as additions that principally concern my own work), and the nomenclature of the vascular plants, which follows in general that of "Part I: Pteridophyta and Spermatophyta" (1940b), has been brought up to date as far as possible; specific and other "trivial" epithets have been consistently decapitalized because I think there is an almost overwhelming case for so doing (cf. Journal of Ecology, XXXI, p. 93 (1943), and XXXIII, pp. 308 *et seq.* (1946)). The nomenclature of the Thallophyta and Bryophyta is in accordance with Part II, which was completed early in 1939 but for various reasons remained substantially unaltered when it went to press early in 1946.

Now that field activity has been resumed it is hoped in due course to prepare a new edition of Part I, to complete Part IV on the "Subarctic Regions", and in a supplement to publish additions to previous parts and some account of the general phytogeography.

Nicholas Polunin

New College, Oxford, England,
March 28, 1946.

McGill University, Montreal, Canada,
Revised to May 9, 1947.

CONTENTS

CONTENTS—*Continued*

CONTENTS—*Concluded*

Illustrations

CORRIGENDA

p. 32 line 32 for "*Nitzchia*" read *Nitzschia*
p. 32 line 58 for "*Minium*" read *Mnium*
p. 39 line 53 *for* "Bryam" *read* Byam
p. 45 line 5 *for* "distinguished" *read* disintegrated
p. 58 line 18 for "*porkonyanum*" read *porkornyanum*
p. 61 line 10 *for* "western" *read* eastern
p. 61 line 39 *for* "likely" *read* liable
p. 75 line 21 for "*Cerastum*" read *Cerastium*
p. 76 line 29 *for* "healthy" *read* heathy
p. 78 line 17 *for* "doomed" *read* domed
p. 82 line 53 *for* "accumlation" *read* accumulation
p. 90 line 7 *for* "whereas" *read* and
p. 93 line 34 *for* "acordingly *read* accordingly
p. 94 caption to Pl. XXIX delete third sentence, i.e. "Faintly . . . . Island"
p. 99 line 3 *for* "fllora" *read* flora
p. 99 *transpose* fourth (also on p. 100) and third paragraphs
p. 111 line 7 for "*pachythallina*" read *pachyphyllina*
p. 118 line 12 for "*nvalis*" read *nivalis*
p. 128 line 51 *for* "communities" *read* habitats
p. 152 footnote (3) *end* first line with comma
p. 169 line 38 for "*fragiles*" read *fragilis*
p. 187 paragraph 3: different figures for heights, etc., are given in U.S.H.O., Pub. No. 77, 1946
p. 196 line 48 *for* "(1)" *read* (local)
p. 197 line 17 *for* "light" *read* slight
p. 209 line 26 *for* "60°38′N." *read* 60°28′N.
p. 213 line 16 *for* "numerouus" *read* numerous
p. 226 line 56 for "*and*" *read* and
p. 240 line 28 *for* "adjacent" *read* contiguous
p. 241 line 34 *for* "62·5" *read* 22·5
p. 262 line 14 before "consist" *insert* near the 'post'
p. 265 line 14 *for* "peculiarly" *read* peculiar
p. 265 line 45 *for* "whereas" *read* and
p. 279 line 9 *for* "hydrophytes" *read* hygrophytes
p. 287 column 1 *for* "Bryam" *read* Byam
p. 291 column 2 *transfer* "x" from line 36 to line 43 *to read* stans x bigelowii
p. 296 column 2 line 42 *for* "corrallioides" *read* corállioides
p. 296 column 2 line 47 *for* "deliser" *read* delisei
p. 297 column 1 line 36 *for* "Bellardi) . . . . . 4" *read* bellardi) 5
p. 302 column 2 line 38 *for* "bracycerum" *read* brachycerum

67243

Part III

VEGETATION AND ECOLOGY

INTRODUCTION

As its title implies, the present work comprises Part III of "Botany of the Canadian Eastern Arctic" and deals with the habitat conditions and plant growth and sociology. An explanatory foreword and detailed introduction were given at the beginning of Part I, on the "Pteridophyta and Spermatophyta" (Nat. Mus. Bull. No. 92, 1940), and further notes and acknowledgments in the introduction to Part II, on the "Thallophyta and Bryophyta" (Nat. Mus. Bull. No. 97, 1947). These first two parts being mainly floristic and phytogeographical, and indicating the authorities and including full citations for all pertinent plant names, taxonomic limits, and published distributions, it is considered unnecessary continually to repeat such details in the present part, on the "Vegetation and Ecology". Where synonyms (with or without authorities) and nomenclatural or other details are given, they usually relate to discoveries made (or at least publications that appeared) only after the commencement of World War II, before whose outbreak Parts I and II were written.[1] In the meantime great advances have been made in our geographical knowledge of the regions concerned, e.g., through our airborne expedition of 1946; all this is being expressed in the new series of 8-inch maps of the Canadian Department of Mines and Resources (Hydrographic and Map Service, Ottawa) and of 16-inch AAF Aeronautical Charts (U.S. Coast and Geodetic Survey, Washington, D.C.).

The *flora* of an area is the sum total of different "kinds" of plants inhabiting it, no matter whether they are scarce or plentiful. The *vegetation*, on the other hand, is concerned largely with the question of relative abundance, being the total "display" that the plants make collectively. Their *ecology* is their relationship to environment, this last being considered in the broad sense as including not only the climatic and other general habitat factors but also autogenic conditions introduced by the plants themselves—particularly as they become aggregated into communities and relieve by shelter or aggravate by competition the everlasting struggle for existence.

Except in certain limited aspects and areas, very little was known of the Botany of the Canadian Eastern Arctic when in 1931 I began the preliminary field studies that have resulted in the present series. This was particularly true of the subjects with which Part III is concerned, and even now our knowledge in some directions is little more than fragmentary. To be sure, numerous visitors from early in the nineteenth century had made botanical collections or observations of a sort within the area, often under trying conditions and sometimes with important results; but most of them had merely contented themselves with gathering the more attractive "flowers" or other obvious vascular plants at one or two points near the coast, and for "observations" had relied on stray notes, their memory, or sometimes even their imagination. The published

[1]By the practical field and herbarium worker lacking wide experience in the Arctic it may perhaps be regretted that it was not possible to publish in Part I artificial keys to all the genera and species of vascular plants that are known to occur or seem likely to be found in the region. It is hoped to publish such keys either as an appendix to Part IV or in a later supplement. No attempt is made in any of these works to give floras of individual districts or stations, as lists can easily be extracted from the general statements or detailed records of the "occurrence" of each species given in Parts I and II.

Figure 1. Sketch-map showing subdivisions of the Canadian Eastern Arctic as follows: (1) Ellesmere; (2) Devon, Cornwallis, and Somerset Islands; (3) Northern Baffin; (4) Central Baffin; (5) Southern Baffin; (6) Melville Peninsula; (7) Northernmost Labrador; (8) Northernmost Quebec; (9) Islands in Hudson and Ungava Bays; (10) West Coast of Hudson Bay (Keewatin).

accounts with few exceptions consisted mainly of annotated lists of species and were useful chiefly for floristic and phytogeographical purposes; the records they contained were brought together and sifted by Simmons (cf. 1913) as far as the insular parts of our area are concerned. These accounts were usually written either by the visiting layman who had made the collection or by some "cabinet" botanist with little or no experience of arctic conditions; in these circumstances any notes they may contain on the vegetation are scrappy or unreliable.

In tackling what is thus an almost virgin though huge field I have been struck by two apparent anomalies. The first was that the vegetation of the southern part of the area was even less known than that of the north,[1] though this is not inconsistent with the northward trend of exploratory activity of the past few decades. The second has been that the more I learned about the vegetation of the area as a whole, the less I felt inclined to generalize about it; for if one impression stands out from among all my studies of the vegetation of the Canadian Eastern Arctic, it is that of extreme (and often to me inexplicable) variability from place to place. Certainly there will long remain a great deal more to discover; nor is our knowledge as yet nearly sufficient to allow of detailed comparison with other arctic or subarctic lands.

In all these circumstances the planning of the present volume was comparatively easy and the scheme followed in it is quite simple. The subdivisions of the region into ten major districts in the manner outlined on pages 1 *et seq.* of Part I, and followed throughout Parts I and II, is adhered to also in Part III; so is the order of citation of districts and ultimately stations as far as possible from north to south and then east to west.

The ten major districts afford the chapter headings of the present part, the information under each being generally subdivided into (a) previous knowledge, and (b) recent, intensive observation. Thus under each chapter heading is given a brief outline of the geographical limits and topography of the major district concerned, followed by a general account of its geology and climate.[2] Then comes a statement of everything about the vegetation that can be gleaned from published reports, sometimes supplemented from the results of recent investigations. Of such general information there is often little, as has already been implied, and particularly because I have attempted to base the accounts on the field observations of reliable investigators rather than on hearsay, second-hand reports, conclusions drawn by travellers during winter, or published accounts in which inference and even hypotheses are inextricably mixed with stated fact. Such "observations" usually seemed best ignored.

Finally, forming the bulk of every chapter except that on Melville Peninsula, on which I have unfortunately not been able to land, come detailed accounts of one or two places in each major district.[3] These "test" places of which detailed accounts are given are those at which I had myself, at the time of writing,

[1] Even in the extreme south, in Hudson Strait, which has been traversed almost regularly for more than three centuries, the vegetation was largely unknown. Thus, as recently as 1932 Smith (p. 30) could give precise, useful data in this connection only from Akpatok Island, which I had investigated the previous year, but which ironically enough is unusually barren even for that inhospitable region.

[2] For a brief composite account of the geology of the Canadian Eastern Arctic as a whole, the reader may most conveniently be referred to Weeks (cf. 1935), and for further information about the climate to Connor (particularly 1930, and cf. 1937), Koeppe (1931, pp. 200 *et seq.*), and Middleton (cf. 1935). The meteorological data in the present work were, however, usually extracted as desired from all the detailed reports available at the time of original drafting; nor is my method of presentation of such data necessarily that of the climatologist.

[3] An index of all place-names occurring in the present volume is given on p. 287. Most places that are considered in detail are marked on the map (in back pocket), and the sketch-map on p. 2 indicates the manner of subdivision of the region into ten major districts. As it was not permissible to mark on the map any names that had not been passed by the Canadian Geographic Board, a full list of the localities mentioned in Part I was given in the introduction to it (pp. 3-11). These localities listed in Part I are with few exceptions localized as to latitude and longitude and inclusive of those mentioned in the present part. The vegetation of several districts which lie south of the 60th parallel of latitude will be described in Part IV, on the "Subarctic Regions."

recently made detailed observations. They have in most instances been selected by their accessibility during Canadian Eastern Arctic Expeditions, and the more intensive observations on their vegetation are limited to within 5 miles (8 km.), at most, of the Hudson's Bay Company's post or other point of call that has given its name to the minor district so constituted. The much greater areas between these districts, and inland, remain little if at all known vegetationally; this constitutes another reason for my reluctance to generalize and for my feeling that this cannot yet be done profitably even in the few instances in which it might be done with reasonable safety. Nevertheless, the exemplary dots thus scattered on an area representing nearly half a million square miles of land alone (and much more if we include salt water) afford a wealth of new information, and should enable any suitably experienced reader to form a definite opinion as to the main characteristics of the vegetation and plant ecology of the region.

Each place that is thus employed as an example is introduced by a brief account, which covers its geographical position, historical or economic significance (if any), topography, geology, etc. This is followed by a detailed description of the main plant communities to be distinguished in the vicinity.[1] The short time available at each place (in some instances only a single day) necessitated the active and often rapid application of quite general methods of vegetation survey; these I had to the best of my ability perfected during the pre-war decade, almost every summer of which, at least, had been spent doing field-work in some arctic or subarctic land. Both the delimitation of communities and the listing of components of examples selected at random have almost throughout the present study been of the "birds-eye view" type, which, when employed by a suitably experienced observer, seems quite sufficient for most purposes when dealing with the vegetation of truly arctic regions. Now that studies in the field have been resumed, similar methods are being employed.

The first care when landing at each place was to get a clear idea of all the outstanding plant communities, which naturally form the mosaic occupying practically the whole area. Such a reconnaissance, and subsequently a classification of the component communities, was usually made during the preliminary collecting and general note-taking for Part I; nor can it be too strongly emphasized that the present part should be used always in conjunction with Part I, which gives (in addition to taxonomic, nomenclatural, and phytogeographical details) a concise statement of what was known at the time of writing about the autecology of each vascular plant species in the area.

As soon as the communities were recognized and classified, each one with its attendant problems could be tackled separately. The investigations were always as full and detailed as time allowed, and usually included careful listing (though this was not always carried out under the most favourable conditions) of test quadrats of stated dimensions, photographs (all those published are of my own taking with a Leica camera), observations of soil depth and acidity (using a B.D.H. capillator and "Four-eleven" indicator), and where possible the formation of an opinion as to the areal importance of the community in the general vicinity. Thus a fair "picture" of the vegetation could be obtained. But because, as on Akpatok Island (cf. Polunin 1934, p. 346), the plants had rarely taken sufficient hold of the terrain to override the drastic physiographic (including edaphic) changes, this picture is also of such changes themselves. Accordingly it is the local *habitats*, rather than the vegetation types which vary with them, that afford most of the main headings under which the plant communities to be distinguished at each place are considered in the present work.

[1] In view of the account already given in Part II (pp. 138-177), and of the fact that I have made no attempt at its investigation since my first expedition into the area in 1931 (cf. Polunin 1935, pp. 189 *et seq.*) no account of the Marine Phytoplankton is offered in the present volume.

So much for the land communities. With regard to aquatic ones it must be noted that although at several places during the expedition of 1936 quite detailed observations were made on the benthic marine algal communities, particularly when snow coverëd the land and prevented ecological survey work thereon, an accident at sea during the return voyage rendered the labels on some of my specimens illegible and caused confusion among so many others that whole sections of my phycological notes became doubtful. All these questionable notes and data had of course to be ignored—hence the frequent paucity in detail where marine Algae are concerned. It is also to be regretted that owing partly to another unfortunate mixing of labels later on, and partly to the manifold difficulties of determination, it has often been impossible to include freshwater diatoms in the lists. Except near the east coast of Akpatok Island in 1931 (cf. 1935), I have made no investigation of the marine phytoplanktonic organisms for the present work, although there is a "flora" of them in Part II, besides an account of such ecological work as has been done on them in or near our Canadian Eastern Arctic area.

It will be noted that whereas "dominance" in the restricted ecological sense implies at least some degree of control (by the "dominant" species) of the physiological factors of the habitat, I have, pending further observations, in the present work employed the term in the wide sense as including mere physiognomic preponderance. Moreover, I have for the time being ignored the rather nebulous objections (mentioned by Cain 1939) to terming completely open vegetation a "community", and have even for convenience spoken of "dominants" in such populations. These matters, and such other general subjects as persistence, dispersal, succession, the recognition of a climatic climax, and the application of Raunkiaer's system of life forms (cf. Raunkiaer 1934, and Tansley 1939), I am holding over for consideration in my forthcoming "Phytologia Arctica", which is to be published by the *Chronica Botanica* company.

For assistance in the identification of specimens as well as in many other ways full acknowledgment to numerous specialists, colleagues, and friends has already been given in Parts I and II. From the data from which these parts were compiled have been drawn also the limits to taxonomic entities and plant names used in Part III,[1] with only a few noteworthy exceptions. These concern nomenclatural changes since Part I was published, the specific ones being *Tofieldia pusilla* (Michx.) Persoon for *T. borealis* (*See* Polunin MS. 1941), *Kobresia myosuroides* (Vill.) Fiori & Paol. for *K. bellardi* (*See* also Mansfeld in Fedde Rep. Sp. Nov., XLV, p. 212, 1938), *Phippsia algida* (Soland. apud Phipps) R.Br. for *Catabrosa algida* because I am now convinced that *Phippsia* is after all a "good" genus, *Carex norvegica* Retz. (*non* Willd.) for *C. halleri* (*See* Fernald in Rhodora, XLIV, p. 304, 1942; Hultén in Lunds Univ. Årsskr., N. F. Avd. 2, XXXVIII, 1, p. 348, 1942; Porsild in Sargentia, IV, p. 20, 1943), *Potentilla hyparctica* Malte for *P. emarginata* (*See* Fernald in Rhodora, XLV, p. 111, 1943), *Stellaria calycantha* (Ledeb.) Bong. for *S. borealis* (*See* Fernald 1940, pp. 254 *et seq.*), and *Senecio congestus* (R.Br.) DC. for *S. palustris* (*See* Fernald in Rhodora, XLVII, p. 256, 1945); these and some minor changes in the nomenclature of vascular plants are upheld in Part III, but the name by which the species or minor entity concerned was known in Part I is given as a synonym each time the plant is cited, full references being appended in a special footnote the first time the plant is mentioned in the general text.

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[1]Hence the omission of *s.l.* (*sensu lato, vel latissimo*) after the names of polymorphic species unless the particular specimen or population referred to was taxonomically far removed from the typical.

Apart from such instances in which I feel convinced the changes are necessary, the nomenclature of the vascular plants in the present volume follows Part I, to which reference may be made for details, though further changes appear likely to prove desirable or yet unavoidable, e.g., in the genera *Agropyron* (*See* Hultén *op. cit.*, p. 258), *Antennaria* (*See* Porsild *op. cit.*, pp. 68 *et seq.*), *Armeria* (*See* Polunin in *op. cit.*), *Cystopteris* (*See* Hadač in Skr. om Svalbard og Ishavet, No. 87, pp. 9-10, 1944), *Lychnis* (*See* Porsild *op. cit.*, pp. 33 *et seq.*), and *Saxifraga* (*See* Hadač *op. cit.*, pp. 46-9). The nomenclature of the non-vascular plants follows that adopted in Part II, whose general text was completed shortly before the outbreak of war and not altered subsequently.

In the preparation of Part III I have also received much special help that could not be acknowledged before. Particularly do I wish to thank Miss Edith Scamman, M.A., of Saco, Maine, for her tireless assistance in following up and abstracting obscure literature as well as for her generous help in several other ways, and Mr. D. A. Nichols, B.Sc., lately of the Geological Survey of Canada, for expert geological advice most freely given both in Ottawa and during the Canadian Eastern Arctic Expedition of 1936. Almost all of the hitherto unpublished geological observations that are made in the present work are either due to, or have been "vetted" by, Mr. Nichols. Before the 1934 expedition I benefited much by ecological discussions with the late Prof. G. E. Nichols of Yale, before the 1936 one by discussions of many kinds with Dr. Hugh M. Raup of Harvard and Mr. A. E. Porsild of the National Herbarium of Canada, and before the Labrador and Akpatok Island studies of 1931 with Prof. A. G. Tansley, F.R.S., of Oxford. The last-named friend and Sir Edward Salisbury, C.B.E., F.R.S., have also been kind enough to discuss with me the planning of the present work, and Prof. T. G. B. Osborn has helped with the revision of parts of the manuscript. Most other indebtedness is acknowledged in the appropriate place in the text; but I would like here to thank Eric Arthurs, Chief Laboratory Assistant in the Department of Botany, Oxford, for his careful printing from so many of my tiresomely small negatives, and my past and present assistants, Elisabeth Koutaissoff, B. Litt., and Mrs. Hermia Clokie, M.A., for their tactful patience and intelligent industry. It is not through lack of diligence in their searching and abstracting, nor the fault of my secretary, William Scott Oliver, but a result of the previous widespread apathy to the fascination and importance of the study of vegetation, that so little (often nothing) of value to the present subject can be cited from the works of Amundsen, Franklin, Hall, Hayes, Inglefield, Kane, Kennedy, MacMillan, Sherard Osborn, Peary, Rasmussen, John Ross, Snow, and other visitors to the region. Finally, it is a pleasure to thank my secretary at McGill, Miss Frances E. Batchen, M.A., for her painstaking assistance with the compilation of indices.

(1) ELLESMERE

Ellesmere is the northernmost large island of the American Arctic Archipelago, extending from latitude 76° 8′ N. to latitude 83° 8′ N., and from longitude 61° W. to longitude 92° 30′ W. (Simmons 1913, p. 34). Actually, it is among the largest islands of the world, being nearly 600 miles in length and having an estimated area of 75,024 square miles (Bethune 1935, p. 16). Of this a considerable proportion is covered by locally centred ice-caps or smaller *névés;* indeed in most parts of the east and south coasts, which alone have been well investigated botanically, the ice-free areas of land are limited to mountain tops, cliffs, and narrow strips near the shore, the hinterland even at comparatively low altitudes being generally ice-bound.

The outline of the island is in most places rendered very irregular by fiords of varying length (*See* map), the land being in general high and broken, although the architecture of the mountains is inconsistent through variation in the geological nature of the rocks. The north coast is, however, fairly even in outline, and in the west of the island there occur considerable stretches of low ground. It is on these plains that the largest herds of musk-oxen are to be found. Elsewhere, glaciers descend to sea-level at frequent intervals, usually "calving" right into the sea and; accordingly, dissecting the tracts that can support vegetation and limiting the possibilities of plant migration. In some places, however, sheltered valleys run far inland from the heads of fiords, and it is here that the most luxuriant vegetation tends to be developed (cf. Greely 1886, I, pp. 279 *et seq.*, and pp. 371-391).

Of the rather interesting explorational history of Ellesmere a sufficiently detailed account has already been given by Simmons (1906, pp. 3-4). It will suffice here to give a summary of our present knowledge of the geology and climate of the land.

GEOLOGY

The geology of Ellesmere is rather complicated (Weeks 1935, p. 139). Exposures of grey, granitic rocks, now known to be of undoubted Archæan age, occur on the south coast east of Harbour Fiord and extend up the east coast as far as Buchanan Bay in the Hayes Sound region. On the west coast such rocks have been found only in Bay Fiord, but on the north coast they are known at several points between Cape Columbia (longitude 69° 30′ W.) and Yelverton Bay (longitude 83°-85° W.). Overlying these granites, which may be gneissic and have sedimentary rocks let down into them by faults, there are most frequently found fine-grained, buff limestones or dolomites at varying elevations. At Craig Harbour on the south coast this light-coloured capping resembles the icing on a cake, whereas in places on the east coast where no limestone is visible *in situ* its presence in morainic material brought down by glaciers indicates that it occurs inland at elevations not found on the coast.

In addition to the above, two areas of early Palæozoic rocks, chiefly Cambrian and Silurian and consisting for the most part of limestones with some sandstones and conglomerates, have been described on Ellesmere by Schei (1904, cf. sketch map facing p. 466).[1] The more southerly has outcrops on Jones Sound between Goose and Starnes Fiords and extends presumably in a northeasterly direction, as similar rocks are to be found in the extreme east of Baumann Fiord and again in Makinson Inlet on the east coast, according to information recently obtained by Mr. R. Bentham. The more northerly area of these early Palæozoic rocks persists along the east coast from Knud Peninsula to at least as far as Scoresby Bay, and thence apparently extends southwestwards, as rocks of a similar character are found at the northeastern extremity of Bay Fiord. Furthermore, a narrow belt of Devonian sediments was determined by Schei (cf. Holtedahl 1917, map facing p. 4) as extending from Bay Fiord in a south-southwesterly direction to the southwestern extremity of the main island, whereas beds of supposedly (in Stenkul Fiord definitely) Tertiary age, usually containing lignite and not infrequently true coal, have been found in numerous places, usually in the valleys (cf. De Rance and Feilden 1878, pp. 331 *et seq.*). The detrital material in these beds has probably been derived from the erosion of the surrounding higher land. On the east and west coasts, at least, of the

[1] As has been pointed out by Mr. R. Bentham, who was kind enough to read this part of my manuscript, the development of arenaceous deposits in Ellesmere is extremely poor. There are some of Silurian age and some belonging to the Tertiary period, but those of other ages are so thin as to be practically negligible.

northern half of the island there occur other young (Mesozoic?) beds of great extent, whereas the Lady Franklin Bay-Lake Hazen region inland is especially characterized by Devonian and Carboniferous deposits supporting vegetation that in its luxuriance is almost comparable with that of the Archæan region of the southeast, which according to Simmons (1906, p. 5) is in general the best vegetated in the land.

CLIMATE

The climate of Ellesmere is of course very severe, even compared with that of many other parts of our Eastern Arctic area. Although much colder temperatures, including many of the lowest ever recorded, are regularly encountered in the continental regions of Siberia, where the summer is comparatively warm, almost the whole of Ellesmere probably falls within the area whose mean temperature in January is generally below —30°F., and whose mean temperature for July, the warmest month, does not exceed 40°F. Ellesmere is thus among the very coldest regions in the world (cf. Connor 1930, maps on pp. 5 and 9), for on one hand the temperature exceeds 50° F. (10° C.) only a few times in the year and has hardly ever been known to reach 60°F., and on the other hand there is hardly ever anywhere a period of as long as a month without frost. Thus at Bache Peninsula, about halfway up the east coast, observations extending over 3 years show that only July and August have most (in each case 30) of their days "without frost",[1] June and September already having frost on about half their days, and May and October very few days without it (cf. Middleton 1935, p. 29). The "summer", and hence the normal growing-season, is thus limited to about 2 months, during which the sun hardly ever sets. Nevertheless, flowers of some hardy species[2] may open early in June and the plants from which they come show signs of activity well before the end of May (cf. Hart 1880, p. 76).

The precipitation in Ellesmere is extremely light, the land being in this respect a mere desert, although owing to the cool temperatures the relative humidity tends to be high (cf. Connor 1937, p. 46). Thus, the records at Bache give a mean annual precipitation of 4·85 inches (123 mm.) of which a large proportion falls in the form of snow in September, October, and November. August is the rainiest and also the cloudiest month, the winter being distinguished by clear skies. The mean annual precipitation in Ellesmere is probably everywhere (at least on the coast; no extended observations have been made inland) below 10 inches. This compares poorly with the 15 inches in southern Baffin and nearly 30 inches in parts of Ungava Peninsula, but it must be remembered that the brevity and coolness of the summer, and the corresponding protraction of the period of melting of the snows, in Ellesmere contribute materially toward making conditions around the surface of the soil relatively much damper than in the south.

The action of winds is of course very important in its effect upon the vegetation, but regarding their strength, direction, etc., it seems safest not to attempt to make sweeping generalizations from the scanty data at present available (cf. Middleton 1935, p. 26). It does, however, seem permissible to conclude that the higher the latitude of a station in the Eastern Arctic the greater is likely to be the percentage of calms. Especially is the prevalence of calms during winter a marked feature in the Far North, and hence in Ellesmere; however,

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[1]Middleton (1935, p. 29) writes "The criterion....... is a minimum temperature in the screen greater than 32°F.; as the minima throughout the summer are chiefly in the thirties, it is probable that the gross minimum temperatures would fall to 32° on the majority of nights even in July and August."

[2]Especially *Saxifraga oppositifolia*, *Salix arctica*, *Oxyria*, and *Papaver*, generally in the order named (cf. Greely 1886, I, pp. 363-4).

winds of surprising force frequently occur, especially in June and September, causing rapid drifting of the snow, which would otherwise cover the ground almost throughout the year. In many places, especially around the heads of the larger fiords in mountainous districts, these strong winds tend to be quite local and of the *foehn* (cf. chinook) type, being accompanied by marked rises in temperature (cf. Kendrew 1930, pp. 297 *et seq.*), and in the summer months causing rapid melting of the snow and evaporation of surface water in the valleys where their effect is greatest. Their effect on the vegetation may be far reaching, as is very obvious in southwestern Greenland (Polunin 1937, p. 939).

The following tables, compiled from Nares (1878, II, pp. 354-5) as regards the two northern stations, and as regards the rest from the "Monthly Record of Meteorological Observations" (published by the Department of Marine, Canada), although they do not always allow direct comparison because they concern such various years and periods of time, still give a useful indication of the conditions of temperature and precipitation to be expected in different parts of Ellesmere, ranging from the extreme north to the south coast.

Month	Temperature °F.			Precipitation	Temperature °F.			Precipitation	
	Max.	Min.	Monthly mean	Total inches	Max.	Min.	Monthly mean	Total inches	Rain or snow
Floeberg Beach, 82° 27′ N., 1875-6					Discovery Harbour, 81° 43′ N., 1875-6				
January	9	−59	−33	0·23	−13	−63	−41	0·36	....
February	2	−67	−38	0·26	2	−62	−35	0·26	....
March	−8	−74	−40	0·18	− 8	−71	−37	0·28	....
April	15	−47	−18	0·24	13	−43	−17	0·35	....
May	33	−15	11	0·71	34	−21	10	0·17	....
June	44	18	32	0·66	41	17	33	0·19	....
July	50	29	38	0·46	46	30	37	0·31	....
August	44	25	32	0·29	41	26	33	0·11	....
September	37	0	16	0·68	43	2	19	0·47	....
October	21	−32	− 5	0·7	22	−39	−10	0·57	....
November	23	−46	−17	0·11	19	−46	−18	0·27	....
December	35	−47	−22	0·55	26	−54	−25	0·36	....
Bache Peninsula, 79° 4′ N., 1932					Craig Harbour, 76° 12′ N., average 1934-6				
January	−1	−40	−29	0·1	8	−43	−21	0·54	S
February	11	−46	−24	0·4	7	−43	−22	0·27	S
March	29	−35	−13	0·05	13	−38	−17	0·48	S
April	13	−30	− 8	0·1	20	−27	− 3	0·87	S
May	44	−14	23	....	36	−12	15	0·43	S
June	50	17	34	....	50	15	33	0·91	S, and a little R
July	53	30	40	0·44	57	31	43	0·65	S, and a little R
August	......	......	....	....	51	27	38	2·05	R, S
September	......	......	....	....	43	15	30	0·43	S, and a little R
October	25	− 7	7	1·1	35	− 5	13	1·52	S
November	5	−33	−11	0·2	25	−28	− 5	0·31	S
December	0	−38	−24	0·1	8	−38	−17	0·23	S

VEGETATION

As is usual with far northern lands where the plants scarcely anywhere take a real hold of the surface, or (except to the trained eye of the specialist) appear really to affect the general landscape, the flora of Ellesmere is far better known than the vegetation. Indeed, few visitors to those bleak shores seem to have separated these two primary attributes, even if they have been

biologically minded enough or trained to take an interest in the ecological requirements and distribution of individual plant species. I have unfortunately had an opportunity of investigating only one point, whose plant communities I will describe in detail below; for the following more general statements about the vegetation of this great land-mass I have had to rely upon the occasional scattered references in the accounts of the larger expeditions to Ellesmere, in the resulting botanical papers (either general or floristic), and in the sayings and writings of certain friends and correspondents who have spent some time on the island. The accounts of the vegetation are often so vague and the information so scrappy that I have found it best merely to quote most of the statements; even Simmons's excellent works of 1906 and 1913 are almost entirely floristic or phytogeographical; indeed, until my first visit to Craig Harbour in 1934, no one seems to have taken the slightest interest in the plant sociology of any part of this huge island.

Our scanty knowledge of the vegetation of the north coast of Ellesmere, which is specially interesting in that it persists farther north than any other known land with the exception of a small part of Greenland, we owe almost entirely to the observations of Sir George Nares and other officers of his ship H.M.S. *Alert,* which wintered off Floeberg Beach, latitude 82° 27′ N., in 1875-6 (cf. Nares 1878). Captain H. W. Feilden, naturalist to the *Alert,* reports (in Hart 1880, pp. 114-5) that "Northward of Cape Union (lat. 82° 15′) . . . . the coast-line at many points is made up of gravel ridges or slopes of mud, old sea-bottoms in fact, stretching landwards to the first range of hills, which rise to a height of 600 or 700 feet. Inland of this old coast-line, many elevations rise to a height of 1,200 or 1,500 feet; whilst still further may be seen in the distance a sea of snowy peaks, attaining an estimated altitude of 5,000 feet. In the northern portion of Grinnell Land, around Floeberg Beach, plants were most plentiful along the shore-line and in the valleys up to an elevation of 300 feet; but in some favoured spots we found luxuriant patches of sorrel and grasses even at 600 or 700 feet. The richest vegetation occurred on the northern slopes, as these obtain the greatest amount of the sun's rays during the warm months.[1] The most northern point I visited was the neighbourhood of Cape Joseph Henry (lat. 82° 50′) in the end of May and beginning of June; at that season the winter snows had scarcely begun to thaw, but the action of the winds exposed here and there withered remains of prior season's growth; *Salix arctica* was here quite as large and abundant as at Floeberg Beach, a specimen gathered near Cape Joseph Henry in lat. 82° 46′ had a stem seven-tenths of an inch in diameter; withered stems of *Papaver nudicaule,*[2] *Draba alpina, Cerastium alpinum, Potentilla nivea,*[2] *Dryas integrifolia, Saxifraga oppositifolia,* and two grasses were gathered here. My impression is that in this locality the plant growth scarcely differs from that in the neighbourhood of Floeberg Beach. On the 6th June, at Floeberg Beach, I obtained a single blossom of *Saxifraga oppositifolia,* the first flower observed; by the 12th it was in full flower, and so abundant that some of the northern slopes near the sea-shore were suffused with a purplish glow when seen at a distance. *Lychnis apetala* I have noted as the latest plant to flower; I first saw it blossoming on the 25th of July. With the exception of *Cochlearia officinalis,* of which I found only two or three stunted plants north of Cape Union, I did not observe that any of the other species collected by me at Floeberg Beach differed in size or luxuriance from

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[1]As Hart (1880, p. 115) remarks, "it is well to observe that it is due to the configuration of the land that northern slopes obtained the greatest amount of sun's heat in Captain Feilden's latitudes. Eastern and southern slopes are the most favoured around Discovery Bay " (N.P.)

[2]These are now referred to other species, *See* Part I of the present series. (N.P.)

similar species growing at Discovery Bay; though the entire failure of so many plants in so few miles of latitude is worthy of consideration. I think I may safely say that *Oxyria reniformis*[1] was the plant which grew most luxuriantly at the highest elevation around Floeberg Beach."

Of this last place Nares (1878, I, p. 137) says "the undulating hills stretching away for a dozen miles are, apparently, perfectly bare of anything likely to attract game to visit us; a few hollows are vegetated, but very sparingly so", and, later (p. 144), "On visiting the shore we picked up a few pieces of seaweed (*Laminaria*) that had been cast up". Nares also remarks on several occasions that the temperature (which descended to –74°F.) and wind were much more variable on the north coast than at Discovery Harbour, but still observes (1878, I, p. 238) for the former that "On examining a plant of *Saxifraga oppositifolia*, which has not been protected by any snow, and therefore has been exposed to the severest temperature, green buds were distinctly visible" (on the twelfth of February).

Of the country inland of Floeberg Beach, where the English party wintered successfully in 1875-6, farther north than any had done hitherto, Markham remarks (1878, p. 383) "Some of the hills . . . were beautifully carpeted with the pretty little purple saxifrage, a *draba*, a *potentilla*, and other wild flowers, while the valleys were covered with patches of luxuriant vegetation, consisting of grasses and delightfully soft moss."

Hart (1880, pp. 73 *et seq.*) gives a detailed account of the environs of Discovery Bay, latitude 81° 43′ N. in Lady Franklin Bay, where he spent almost a year. To him "Discovery Bay yielded sixty-six flowering plants. . . almost all. . . to be found close to the harbour, and several not elsewhere; with one or two exceptions the whole flora of Grinnell Land is to be found upon Bellot Island in Discovery Bay. Four principal valleys intersect this country. . . . In these valleys and upon their slopes with a southern aspect, or about their entrances near sea-level, is to be found most of the vegetation of the district. Inland, and between these valleys, the general appearance of the surface is a vast, barren table-land, or series of table-lands from 2,500 to 4,000 feet, clad in perpetual snow, with here and there blown bluffs or bare declivities. These stretch away westward to meet the inland range of mountains. . . . The most luxuriant growth at this latitude is found on banks facing from south to east at from two to five hundred feet above sea-level. . . . Although there is a deep clay in the valley in many places, the surface is for the most part barren; when the thaw sets in, this clay and large pieces of mud banks from the brows and valley-slopes become disintegrated, and, sliding down, are carried by torrents towards the sea. Sometimes plants, especially *Salix arctica*, successfully exert a binding effect and partially arrest this wholesale denudation, but it is common to see blocks of half-frozen mud and ice containing plants and roots torn out and hurried to the shore."

Hart continues (1880, p. 75), "As a rule the various flowering plants occur in tufts or patches, the same species growing in considerable quantity at each station, and perhaps not again to be met with, or not for a considerable distance; green colonies are sometimes thus formed, the brightest and largest of which will be found to belong to *Carex fuliginosa*[2]. . . . Many plants, though occurring in clusters, by no means give a green effect to the landscape, *Epilobium latifolium*, *Salix arctica*, and others never hiding the shingle upon

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[1] See footnote (2) on p. 10.

[2] *Carex misandra* R.Br. (N.P.)

which they grow—most sedges and all grasses only grow in tufts, or by sending up single separate stems with little or no leaf-growth. *Dryas integrifolia* forms sods of rich brown turf, while the Saxifrages as a rule cover much ground with a greenish brown growth. The rock *in situ* forming this part of Grinnell Land is azoic, and generally a black clayey shale . . ."

Later, on page 76, Hart remarks of the Lady Franklin Bay region that "Besides the difficulties due to the climate, there are others in the way of plant-growth; lemmings swarm here, and subsist entirely on vegetable matter, which is also the support of numbers of hares, musk oxen, ptarmigan, and brent geese. Individuals of these watched or dissected by me led to the following conclusions: the musk ox will eat almost any herbage, but seemed especially fond of *Carex fuliginosa*[1] and *Salix arctica;* the brent goose prefers shoots and heads of *Ranunculus nivalis, Eriophorum capitatum,*[2] and *Cerastium alpinum*; *Saxifraga caespitosa*[3] was the favourite food of hares[4] . . . ptarmigans appear to subsist entirely upon willow tops (*Salix arctica*)[5]; the reindeer will reject everything for *Stellaria longipes,* while the seed tops of Drabas and Poppies form the chief food of the snow bunting[6]; *Saxifraga oppositifolia* and Drabas support hosts of lemmings, and the former is no doubt eaten by all in the early part of the season, being the first to form fresh growth."

Then again (pp. 77-8), "On the sides of mountains with a southern aspect, I estimated the line of perpetual snow in the neighbourhood of Discovery Bay at fourteen to fifteen hundred feet above sea-level. Spaces blown clear of snow occur at higher levels upon exposed ledges, hillocks, etc., and these will still support a few of the hardier flowering plants. The snow-fall is, however, never of any great depth, and during the winter of our experience did not probably exceed a foot and a half at the most, except where drifted. Upon the vertical range of species I made the following observations with an aneroid:—At 2,000 feet occur—*Papaver* . . . . , *Draba alpina, Saxifraga oppositifolia, S. caespitosa.* At 1,500 feet—*Poa arctica, Cerastium alpinum, Stellaria longipes.* . . . At 1,400 feet—*Saxifraga cernua, Oxyria.* . . ., *Saxifraga flagellaris, S. nivalis, S. tricuspidata, Alopecurus alpinus, Potentilla nivea,*[7] *Cerastium latifolium*[8]".

Many of Hart's statements that follow the above, in particular those concerned with general conditions and phytogeography, are to be accepted only with extreme caution, if at all, in the present condition of our knowledge.

Of the Discovery Bay district Nares remarks (1878, II, pp. 140-1), "On the southern slopes of Bellot Island, which was sheltered from the north winds and received the full force of the mid-day sun, the vegetation was remarkably rich. Six species of saxifrage were common, and the beautiful *Hesperis,*[9] with its lilac blossoms, attained a height of eight or ten inches; considerable patches were also covered with *Androsace septentrionalis,* and a single species of fern grew abundantly under the shelter of boulder rocks. Many other plants, which I have

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[1] See footnote (2) on p. 11.

[2] *E. scheuchzeri* Hoppe. (N.P.)

[3] Presumably subsp. *eucaespitosa* Engler & Irmscher, which is by far the commonest subspecies in the Canadian Eastern Arctic (cf. Polunin 1940b, p. 256), where it is frequently reduced to its depauperate f. *uniflora* (R.Br.) Engler & Irmscher, especially in the Far North. In the present work subsp. *eucaespitosa*, like the typical form of any other plant, may be understood to be the one referred or at least approximated to when there is no other designation. (N.P.)

[4] Contrast Soper (1928, p. 61) and Greely (1886, I, pp. 104-5). (N.P.)

[5] Not in summer, *See* Gelting (1937, p. 187). (N.P.)

[6] At least in late summer, as I have noticed also in Spitsbergen. (N.P.)

[7] Probably *P. hyparctica* Malte in Rhodora, XXXVI, p. 177, 1934 (*P. emarginata* Pursh var. *typica* Abrom. *See* Fernald in Rhodora, XLV, p. 111, 1943) or *P. rubricaulis* (*See* Part I of the present series). (N.P.)

[8] Probably *C. regelii* Ostenf. (N.P.)

[9] *Erysimum pallasii* (Pursh) Fernald. (N.P.)

not enumerated, were collected on the same spot, and it would thus appear that a favourable combination of soil, shelter from winds, and a full exposure to the sun have more to do with the development of flowering plants in the Polar regions than parallels of latitude".[1]

Of this same Lady Franklin Bay region, Greely, who was unfortunately not a botanist, writes (1886, I, p. 81), "The adjacent brook-slopes and margins were clothed with vegetation, composed of thick beds of *Dryas*, or clusters of *Saxifraga*, varied with sedges, grasses, or the familiar buttercup.[2] Higher up, on glacier-drift of clayey nature, countless Arctic poppies of luxuriant growth dotted with fair yellow the landscape". Of the feeding of musk-oxen in this district Greely writes (1886, I, pp. 104-5), "The circumstances . . . . afforded me an excellent opportunity of observing the manner in which these animals obtain their food in winter . . . . Moving from one patch of *Dryas* or *Saxifraga* to another, the animal with its hoof scraped away carefully the snow from the plants, and later supplemented their action by the further use of horns or proboscis. . . . .Their food at that time was almost entirely *Dryas*. . . . . and *Saxifraga oppositifolia;* the grasses and lichens were almost entirely lacking, and in no case did I ever note the musk-ox feeding on the latter vegetation, although in many cases near Conger the ground was covered with scanty, minute lichens for acres in extent."

That the interior of Grant Land is far from barren or universally ice-bound to the west of Lady Franklin Bay will be evident from the following observations of Greely (1886, I, p. 370) on the Lake Heintzelman district in June. "In the vicinity of this spot the remains of dead willows existed in sufficient quantities to enable us to cook our tea with it. . . . . In its whole extent the valley was entirely barren of snow, and in most places was covered with a comparatively luxuriant vegetation. This consisted generally of willow, saxifrages, and dryas, though where the river widened, in occasional places, grasses or sedges to a height of ten or twelve inches were frequently noticed".

A little further on (p. 371) Greely writes of the same region "The country now opens into a fine level valley about a mile and a half wide, covered in the main by a very considerable quantity of grass, which in its manner of growth and appearance resembles the bunch grass of our western prairies. In addition there are many young willows, saxifrages, dryas, etc. Enough dead willows can be gathered at almost any spot for the requirements of any sledge party".

Of the vicinity of Lake Hazen, which lies in the same region and is the largest known freshwater lake in the Arctic Archipelago north of Nettilling Lake in Baffin, Greely writes (1886, I, p. 279) "The ascent to the southward was very gradual, and no high land in that quarter was visible. Much grass, many willows, and other vegetation abounded, while, to my surprise, not more than a quarter of the ground was then covered by snow" (this was on May 2, and Greely was travelling "to the westward along the south shore of Lake Hazen"). Of a plateau a short distance from Lake Hazen, Greely writes (*l.c.*, p. 391) "The vegetation was the most rank I have seen in the polar regions. Grass in considerable quantity grew at the margin of. . . shallow lakes to the height of eighteen or twenty inches", and later (p. 414), in summarizing the results of the summer journey

[1] From the material brought back by Nares's expedition Sir J. D. Hooker (1878, p. 307) quite rightly concludes that the vegetation of northern Ellesmere is much more luxuriant than that of Franz Josef "Land" which lies at a similar latitude in the Old World. A fact that Hooker did not, however, realize is that Franz Josef is an archipelago of exposed islands whereas Ellesmere is a great land-mass whose surrounding islands are often quite as barren as the components of Franz Josef.

[2] Probably *Ranunculus nivalis* L. or *R. sulphureus* Soland apud Phipps. (N.P.)

inland on which the above observations were made, Greely notes "The discovery of numerous valleys covered with comparatively luxuriant vegetation, which afford sufficient pasturage for large numbers of musk-oxen".

To what extent it is true of the rest of Ellesmere that the vegetation inland is more luxuriant than that of the coast, only future research can show; at the moment I am a little sceptical as to the justifiability of Simmons's generalization (1913, pp. 26-7), at least if we include the heads of the longer fiords as belonging to the coast,[1] that "What we know in respect of botany is generally nothing but the flora and vegetation of the coast, and we know well enough by experience, that those are always in an arctic land far inferior to those of the inner land—provided that it is not entirely glaciated". Meanwhile it appears that on the eastern and southeastern coasts of this northern half of Ellesmere the vegetation is indeed scanty, little except *Salix, Papaver,* and Saxifrages being noted by the earlier visitors (e.g., Hayes 1867, p. 341; Markham 1878, p. 84; Greely 1886, II, p. 87), though inland even of the exposed northeastern coast the vegetation may be relatively luxuriant (*See* above), as it may be already near the sea in some bays on the east coast (cf. Greely 1886, II, p. 93).

Among the various investigators of the southern half of Ellesmere, pride of place must undoubtedly be given to the members of the Second Norwegian Arctic Expedition in the *Fram,* who spent most of the period 1898-1902 in this region. The botanist of this expedition, Herman G. Simmons, was a man of sound training and exemplary industry, and he must be acknowledged the father of botanical studies in this part of our area. From his "Flora of Ellesmereland" (1906) I drew freely in compiling certain sections of Part I of the present series; unfortunately Simmons did not write about the plant communities, or about the vegetation except incidentally and in the most general terms. Thus in his abovementioned work Simmons has numerous autecological notes of value, but practically nothing from which we can advantageously draw for our present purpose; more useful is Simmons's "Preliminary Report" (1904), from which the following quotations seem most apposite.

At first, on visiting the Hayes Sound region of the east coast, west of where Greely (cf. 1886, II) and his party in 1884 were able to gather little except *Saxifraga oppositifolia* and lichens to live on, Simmons rather deplored the scantiness of the Ellesmere vegetation, even compared with that of adjacent parts of West Greenland (e.g., Foulke Fiord and Etah), for he writes (1904, p. 468) ". . . the luxuriance of the Foulke Fjord vegetation far exceeds that in any other place I have seen north of Danish Greenland. In no other part was the country so extensively green; or in other words, vegetation, and not rock, determined for large areas the tint of the landscape. In great measure this luxuriant vegetation was brought about by the manure provided by the millions of little auks which breed here. This was particularly the case on the slopes near Etah, where *Alopecurus alpinus* reached to a height of a foot and a half, and many other species here were larger and more vigorous than elsewhere in these northern tracts, a circumstance which could hardly have been the case but for this fertilization. A vigorous vegetation also clothed the vicinity of the old Eskimo settlement, Etah, and I found there species which I saw nowhere else".

However, a little later on the same and the following page Simmons writes "My impression of the vegetation of Ellesmere land was improved by two subsequent excursions . . . in particular one to Cape Rutherford, where we landed on Aug. 21. Here the vegetation was close and luxuriant over considerable parts

[1] Such inclusion seems justifiable as it is so frequently in these fiords that landings are made during arctic expeditions.

of the plateau which constitutes the interior of the peninsula. Particularly noticeable was *Papaver radicatum*, which. . . . was still in full bloom. Other flowers were also in bloom, probably because the snow had lain long, and they had been late in regaining their functional activity. On the slope leading down to Rutherfordeidet, on the other hand, where, on account of its favourable aspect, 'spring' was considerably earlier than on the plateau, nearly all the flowers, with the exception of *Saxifraga tricuspidata*, were over. I saw, among others, *Myrtillus uliginosa*[1] and *Cassiope tetragona*[2] as well-grown as in Foulke Fjord". Thus, Simmons appears to have understood from the first the extreme importance and true significance of snow-covering to local vegetation; indeed he seems to have been the first visitor to the Canadian Eastern Arctic to do so.

On the same Hayes Sound region Captain Sverdrup, in his general account of the Second *Fram* Expedition, writes (1904, I, p. 53) of Flagler Fiord (latitude 79° 4′ N.) that ". . . , we made a trip round the fjord, under the glacier, and we then realized what a splendid game-country we had unexpectedly hit on. The vegetation was incredibly luxuriant,[3] and the whole place swarmed with big fat hares, of which we shot a leash."

Later on, of "the big valley leading across from Nordfjord to the west coast", Sverdrup mentions (*l.c.*, p. 152) that " . . . . in some places [it] showed unusually rich vegetation", and of the nearby Beitstad Fiord he writes (p. 162), innocently enough but quite erroneously as far as the first-named plant is concerned, that "In the fine weather we were now having, this fjord-arm, with the high mountains round it, looked most beautiful. It was full summer in here, and the grass was very abundant, growing in waving patches for long distances together, in which were multitudes of red and yellow sweet-scented flowers. Here we found our dear old friends, the lovely little Linnaea, the buttercup, saxifrages, and many other kinds. In fact, I feel almost tempted to recommend Beitstadfjord as a summer resort—but only in fine weather".

Simmons (1906, p. 5) gives some useful generalizations in the introduction to his "Flora of Ellesmereland", as follows: "The Hayes Sound region is built principally of archæan rocks, which as far as is known, continue along the coast southward, and as far into Jones Sound as to the west side of the Harbour Fjord. This is by far the richest ground, both in number of species and denseness of vegetation. Out of the 109 species found in the regions I have examined, 22 only are found[4] in the archæan territory, whereas 5 only are found[4] outside it. The Cambrian and Silurian deposits are the poorest of all, therefore the flora of most parts of the coast line to the west along Jones Sound is very poor in species, and shows a stunted vegetation. The same seems also to be the case in the Bache Peninsula and along the Grinnell Land east coast, which is formed of the same strata. The Silurian limestones especially give an extremely poor soil". Already Simmons had elsewhere (1904, p. 471) reported in similar vein, after a trip from Harbour Fiord westward to the inner part of Muskox Fiord, that "As during these excursions I passed the limit of Archæan rocks, I had a good opportunity of observing how much richer these are, both in regard to the closeness of the vegetation and the variety of species, than the Silurian strata,

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[1] *Vaccinium uliginosum* var. *alpinum* Bigel. It reached a height of 8 or 10 inches in especially favourable localities (Simmons 1906, p. 38). (N.P.)

[2] Simmons writes (1906, p. 39) of this that " . . . in favourable localities it can sometimes attain a height of at least 15 inches". (N.P.)

[3] I can only think that this must have been in comparison with the decks of the *Fram* and the surface of the glacier! (N.P.) According to the late Dr. M. O. Malte the nearby Bache Peninsula coast is unusually barren—*See also* the panoramic photograph published by Craig *et al.* (1927, at back), and cf. Wordie (1938, facing p. 398).

[4] This should, of course, read "are only found". (N.P.)

especially the siliceous limestone which prevails here. The ground formed by its products of denudation may be for large expanses entirely, or almost entirely, without vegetation, at any rate as far as the higher plants are concerned; mosses were of rare occurrence, and the lichens also sparse".

Of the Fram Fiord district of this Archæan region Simmons writes (1904, p. 470) "We stayed there for two days, and as the flora was decidedly rich and the vegetation so vigorous that it reminded me of Foulke Fjord, this short stay gave a relatively good result. The two excursions which I made here brought in the following species, which are new to the Ellesmere Land flora: *Pedicularis lanata, Armeria sibirica,*[1] *Saxifraga Hirculus, Potentilla Vahliana, Eutrema Edwardsii, Braya purpurascens, Pleuropogon Sabinei, Trisetum . . . ., Elyna spicata*[2]".

Sverdrup's account (1904, I, pp. 210-1) of this same district includes the following notes: "Straight from our place of anchorage stretched a large valley in a westerly direction; it was wide and smiling, and sloped gently upwards, with grass- and moss-grown sides, eventually uniting itself with the chief valley. On the east side of the fjord, on the other hand, the mountains rose precipitously, straight up from the sea . . . ashore . . . along the side of the fjord . . . the vegetation. . . was unusually vigorous, and it was one of the most verdant places I saw on the whole voyage. Wherever we went in this valley, we trod on grass or sank into a soft carpet of moss, and this made us feel sure there must be plenty of animal life about. . . the botanist was simply revelling in the plants, of which he had collected quite a load; his case had been filled several times over, and he was in high good-humour".

Sverdrup later notes (*l.c.*, p. 221) of the Harbour Fiord district that "The vegetation of Stordalen[3] was particularly rich in places, and we saw many hares and ptarmigan".

In even more general terms does a recent geological investigator of the region, Mr. Robert Bentham, write (*in litt.*) as follows: "Vegetation throughout southern Ellesmere Island is largely confined to the older of the raised beaches (i.e., those having heights of between about 60 and 250 feet above sea-level). Thus between King Edward VII Point and Makinson Inlet and on to Cape Isabella, there is practically no vegetation, since beaches are poorly developed and glaciation is extensive. However, vegetation is locally more luxuriant on the shores of Jones Sound between Craig Harbour and Grise Fiord, and on Devon Island westwards from Cape Sparbo. In all these localities geological conditions are similar—there are raised beaches with granitic cliffs behind, and thin sandstones and dolomites either capping the cliffs or occurring a few miles inland. Comparatively luxuriant vegetation may occur at any altitude, particularly when circumstances are such as to give rise to semi-boggy conditions in summer. The two valleys entering Fram Fiord and the low land between Cape Sparbo and the main scarp of the north coast of Devon Island are particularly rich."

Of Starnes Fiord, which incidentally lies among his "more luxuriant. . . shores. . .between Craig Harbour and Grise Fiord," Mr. Bentham writes that it "is probably typical of the fiords of southern Ellesmere Island. It cuts through country built up entirely of limestones, calcareous shales, and dolomite, but although raised beaches are present there is little vegetation."

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[1] *Armeria labradorica* Wallr. (N.P.)

[2] *Kobresia myosuroides* (Vill.) Fiori & Paol., Fl. Ital., I, p. 125, 1896 (*K. bellardi* (All.) Degland apud Loisel.—Cf. Mansfeld in Fedde Rep. Sp. Nov., XLV, p. 212, 1938). (N.P.)

[3] I.e., The Big Valley. (N.P.)

The west coast of Ellesmere has been visited only very occasionally and the scanty information I have been able to obtain about its vegetation comes from four main sources, as follows: (1) Captain Sverdrup (1904, I, p. 181) writes "The vegetation on the west coast was everywhere luxuriant, where there was bare land. We brought back with us specimens of, altogether, about thirty-five species of plants. . . ." Then follows a list of the species, which are all rather high-arctic, and "*Cassiope tetragona* was observed, but no specimen taken"; (2) Dr. W. Elmer Ekblaw during the "Crocker Land Expedition" visited Bay Fiord (c. 78° 57′ N.; 81° 25′-85° W.) and noted (1918, pp. 343 *et seq.*) "a great herd of musk-oxen feeding on a wide meadow at the foot of the mountains. . . . Their splendid condition was no doubt due to the excellent pasturage they found on the grassy meadows among the mountains and along the fjord. . . . Large tracts support a relatively luxuriant growth of willow, sedge, and grass, the chief foods of the musk-oxen." To the north, about Greely Fiord (c. 80° 40′ N.; 77°-87° W.) and Borup Fiord (c. 81° N.; c. 84° W.), musk-oxen and vegetation were again "abundant" (Ekblaw 1918, pp. 351 and 353), forming in the latter region "a thick close carpet"; (3) Corporal "Paddy" Hamilton of the Royal Canadian Mounted Police, who has spent more time in Ellesmere than any other white man, accomplishing several long patrols, once told me that almost all the vegetation and game he has ever seen in Ellesmere was on the west coast, where most of the musk-oxen and caribou live, and where the "grass" is "much like that at Pond Inlet"; (4) Mr. Bentham, however, reports of Vendome Fiord that "On either side the country consists of very extensive raised beaches and alluvial plains sloping up to the higher ground of the interior. This country was only examined in a few localities and vegetation appeared to be rather sparse. On the other hand a number of large herds of musk-oxen were seen during the journey down the fiord, so in some localities there must be abundant vegetation." In addition, Simmons (1909, p. 25) quotes his geologist friend Schei as reporting that Big (Stor) Island (latitude 78° 45′-79° 5′ N., longitude 85° 40′-87° W.) has "a rather scarce vegetation on the terraces along the beach." As regards any observations on the vegetation that may have been made by the Danish "Van Hauen" Expedition, which reached western Ellesmere early in World War II, I have so far (April 1947) only been able through correspondence to determine that the botanist "is reported to be somewhere in Iceland".[1] Early in 1947 a meteorological station was established by the Canadian Government in the Eureka Sound region, which may ultimately prove a useful centre from which further investigations can be carried out.

Having thus gathered together all the available information on the general conditions and vegetation of Ellesmere, and noted that the reports are frequently conflicting owing, *inter alia,* to the differing criteria and powers of observation of different visitors, I will now give the results of a detailed ecological survey that

[1] Since this was written I have heard from Mr. J. C. Troelsen, geologist to this expedition, that in western Ellesmere "our botanist was prevented by the season (March to early May) from collecting any phanerogams. The only botanical collections we made in this region consist of lichens, which are now in the Botanisk Museum, Copenhagen." In reply to my request for any notes about the vegetation, Mr. Troelsen wrote *(in litt.)* "In a general way it may be said that the low rolling sandstone hills of western Ellesmere Island support a comparatively (i.e., compared to that of eastern Ellesmere Island) rich vegetation of grasses (and/or *Carex* and *Eriophorum*) and willow. The snow-cover is ordinarily very thin, and ptarmigans, hares, caribou, and musk-oxen apparently have no difficulty in finding sufficient food. Compared to northern Greenland, game is very abundant in western Ellesmere Island, but this may in part be due to the relative inaccessibility of the island."

I carried out during two visits to Craig Harbour on the south coast. Even if Ellesmere, like other great land-masses, varies considerably from place to place in its factors and potentialities, the general indications—especially the occurrence of the same dominants in the southern, central, and northern regions—are that the plant communities described below from Craig Harbour are typical of those to be found almost anywhere in the land. At least these Craig Harbour examples will be broadly illustrative of the communities developed under similar conditions in other parts of Ellesmere, and as such deserve full enumeration and description in detail.

Plant Communities Around Craig Harbour

Craig Harbour is a deep and relatively sheltered cove near King Edward VII Point on the south coast of Ellesmere. It lies in latitude 76° 12′ N. and longitude 80° 56′ W., and is chiefly notable as the only place in Ellesmere that has been inhabited during recent years. The usual inhabitants have been two "Mounties" and a few attendant Eskimos. The "detachment" was established in 1922 but abandoned early in the second world war, until which abandonment it was the farthest north inhabited place in Canada and the farthest north post office in the British Empire. There was only one "mail" a year, when the relief ship R.M.S. *Nascopie* called for a day or so in August or September.

The physiography of Craig Harbour is rugged, with tall cliffs or mountain slopes rising to more than 1,000 feet (305 metres) from the sea or sides of the gently sloping plains that terminate the cove, and which stretch for a mile or more behind and to the southeast of the R.C.M.P. detachment. At the raised back of the plains, on the side away from the sea, are steeper slopes or tongues of glacier that descend into the valley but do not here reach the water. There is little doubt that until comparatively recent times these coastal regions were much more extensively covered by ice than they are now; indeed this probably applies to the whole land.

The prevailing rocks of this district of complicated geology are fresh-looking, dark reddish or chocolate-coloured granites capped by a few feet of sandstones succeeded by a thicker layer of dolomite. There is frequently more granite above this. The valley bottom is occupied by recently outwashed glacial material partly covering and partly intermixed with marine deposits.

The dark granitic slopes are much streaked by long screes of light-coloured dolomite or gullies filled with *névé*, and in places snow patches persist throughout the summer right to sea-level (Plate I). The general aspect from the sea is one of desolation and complete barrenness almost everywhere, but through glasses it is possible to see that the raised beaches flanking the fiord and valley support vegetation of a sort, and the plains where undisturbed are darkened by a meagre plant investment in the manner described below. Elsewhere the ice-free area bordering the coast is generally narrower, and more dissected by broad glaciers that frequently come down to the sea. No wonder the average viewer thinks of this land as being, in a manner I have heard described, "incapable of supporting plant life of any kind". However, the following outstanding habitats and attendant plant communities may be noted in the immediate vicinity of Craig Harbour alone.

PLATE I

Typical steep granite slopes streaked with dolomite screes and gullies filled with *névé*. Much nearer the camera are ice-pans stranded at low tide. Craig Harbour, Ellesmere, Sept. 16, 1934.

PLATE II

Plateau interrupted by patches of new snow and strewn with granitic boulders and stones supporting only crustaceous and foliose lichens of poor growth. Craig Harbour, Ellesmere, Sept. 5, 1936.

(i) UPLANDS

These, usually covered by ice of varying thickness, occupy almost the whole of the land area in the vicinity of Craig Harbour, although no major mountains are to be seen. Thus, at an altitude of about 1,300 feet (396 m.) the steep slopes and cliffs behind the R.C.M.P. detachment round off to gentle slopes and ultimately flats that stretch westwards for about $1\frac{1}{2}$ km. to the rugged Fram Fiord coast and inland for some 3 km. to the edge of the ice-cap. This ice-free area, which is more extensive than most of those to be seen around, constitutes a plateau that nowhere rises above 1,600 feet (488 m.). The lower edges of this upland area are of the usual dark red-brown granite mixed with dolomitic debris; the upper flats and slight ridges are of granite alone. The snowfall of the district is light and this particular area is free from perennial patches, although to judge by the vegetation and other surface phenomena the drifts in depressions thaw out only toward the end of the growing-season. Occasional large, darker erratic boulders stick up conspicuously here and there, sometimes to a height of 2 m.

The plateau is in most places occupied by rough "stone polygons" (cf. Polunin 1934, pp. 352 *et seq.*), the surface material being so sorted that the smaller stones and more finely comminuted particles come to occupy rounded or polygonal areas, generally 1 to 3 m. in diameter, separated by narrower intervening tracts composed of the larger stones and boulders. These last are in turn rounded and generally from a few to 50 cm. in diameter (*See* Plate II); indeed all the surface material has been worked by ice (perhaps quite recently) and no rock *in situ* was seen on this plateau except at the very edge.

In major depressions and other "late-snow" areas there are often no phanerogams at all in hundreds of square metres, even the larger boulders being here almost entirely devoid of crustaceous lichens or any other plants. In general, however, the boulders have their surface about one-third covered with lichens, the earth and small stones of the polygons being moreover dark in colour and fairly well bound. Growth of both cryptogams and phanerogams is extremely stunted, the latter being on the average confined to a single low tuft, rarely exceeding 15 cm. in diameter, of *Saxifraga oppositifolia* f. *pulvinata* to each square metre; indeed nine out of every ten higher plants belong to this species. *Puccinellia vahliana* was the only other vascular plant that was plentiful enough to be entitled to a frequency degree of more than vr., although all of the following except *Cassiope* and *Dryas* were found at least several times during a walk over the plateau and back:[1]

Saxifraga oppositifolia f. *pulvinata*	o-f
Puccinellia vahliana	
Arenaria rubella	
Cardamine bellidifolia	
Carex nardina	
Cerastium alpinum[2]	
Draba alpina var. *nana*	
D. subcapitata	
Luzula confusa	
L. nivalis	
Papaver radicatum	
Phippsia algida (*Catabrosa algida*)[3]	

[1] In spite of the fact that frequent patches of new snow, as shown in the photograph, made observation rather difficult.

[2] The only plant seen to be still in flower on the plateau in the first week of September 1936.

[3] *Phippsia algida* (Soland. apud Phipps) R. Br. in Suppl. App. Parry's ('First') Voyage, p. cclxxxv (mispaged clxxxv), 1824; true Catabrosas have e.g. a different basic chromosome number, the *concinna* element being in reality a *Phippsia* (contrast Part I of the present series, ed. 1).

Poa abbreviata
P. arctica
Potentilla sp.
Saxifraga caespitosa
S. cernua
S. nivalis and var. *tenuis*
S. tricuspidata
Cassiope tetragona seen only once
Dryas integrifolia seen only once

That both flora and vegetation on this plateau were very much poorer than in many parts of the valley will be seen on comparing some of the lists given below for limited areas of a single habitat near sea-level.

New snow and poor light impeded my investigation of the cryptogams, but the following were gathered on a 4-metre quadrat whose only phanerogams, besides the usual tufts of *Saxifraga oppositifolia* f. *pulvinata*, were single plants of *Cardamine bellidifolia* and *Draba alpina* var. *nana:*

Musci	*Rhacomitrium lanuginosum*	f tufts up to 20 cm. diam.
	Dicranoweisia crispula	o
	Distichium capillaceum	
	D. inclinatum	
	Ditrichum flexicaule	
	Hypnum revolutum	
	Rhacomitrium canescens	
	Tortula ruralis	
Lichenes	*Rhizocarpon geographicum*	f-a
	Ochrolechia frigida	f
	Alectoria ochroleuca f. *septentrionalis*	f
	Buellia atrata	
	Cetraria nivalis	
	Dactylina arctica	
	Gyrophora proboscidea	
	Stereocaulon alpinum	
	Caloplaca elegans	

With the exception of the almost ubiquitous *Rhacomitrium lanuginosum*, mosses were far less in evidence than lichens; almost all these cryptogams are, like the phanerogams, typical high-arctic species. However, in spite of the general barrenness, snow buntings (*Plectrophenax nivalis*) were plentiful, and I saw more rock ptarmigan (*Lagopus rupestris*) on this exposed plateau of the Far North than anywhere else during the Eastern Arctic Patrol of 1936.

At the lower levels toward the edge of the plateau there occur outcrops or detrital heaps of light-coloured, biscuity sandstone or dolomite that does not effervesce with HCl. These rocks weather rapidly to give an abundant light mineral "soil", which supports most of the phanerogams listed above from the general plateau; but cryptogams are almost entirely lacking, so that the aspect is one of yellowish or brownish grey desolation, relieved here and there by dark erratics whose more stable surface allows them to be further darkened by an investment of lichens.

Above the slopes that form the back of the cove there stretch other less extensive plateaux, again starting at about 1,300 feet and interrupted behind by the ice-cap. The vegetation is very sparse and altogether much like that of the plateau behind the R.C.M.P. detachment, including almost all of the phanerogams listed on pages 20-21. Out of the ice-cap, chiefly toward its margin or between the glaciers coming from it, there project frequent rounded hills of varying size and probably recent emergence. It is of interest and unusual significance to note that on visiting one of these, which was separated from the nearest land by a tongue of glacier about 300 m. wide, I found that,

far from being entirely barren as I had expected, it was actually better vegetated than the usual plateau at a similar altitude nearer the sea. This "island" was some 200 m. in diameter and projected about 6 m. above the general level of the surrounding ice, which flowed *around it* (i.e., the island was not being carried on the glacier as a drumlin). It was covered by loose morainic material, chiefly of dolomitic origin, and supported most of the phanerogams of the plateau, including *Papaver radicatum* whose capsules had almost all been split open and the seeds extracted by birds. In a runnel of glacier water was a thick culture of *Staurastrum rhabdophorum* growing among luxuriant green and reddish brown mosses and yellowish green filamentous Algae, among which grew some plants of *Saxifraga rivularis* that had fruited well. *Saxifraga cernua* was quite abundant just here.

(ii) SCREE AND OTHER SLOPES

It will already be evident from the foregoing that screes and other steep slopes occupy much of the area around Craig Harbour and, accordingly, cannot be neglected in this account of the terrain and vegetation. These slopes are, of course, extremely variable in their composition and stability, and in the angle that they make with the horizontal; only a few of the types met during my climbs on to the plateau need be described here as examples.

PLATE III

Screes of light-coloured dolomite streaking the underlying granite and forming large pyramids of accumulated debris at their bases. In the foreground and for some distance behind are numerous ice-pans stranded on the shore at low tide. Craig Harbour, Ellesmere, Sept. 17, 1934.

The screes composed of light-coloured dolomite and sandstones, which in many places come down from the edge of the plateau or from weathering crags, are dynamic and for the most part barren. As is seen in Plate III, they tend to form large pyramids of accumulated debris at their bases. The

component material of these screes will often be seen or heard to move even without being touched, and climbing is rendered difficult and sometimes dangerous. Nevertheless, a close search even in the most active "young" screes generally reveals the presence of occasional crustaceous lichens, although their growth is very limited. The blocks of sandstone or dolomite are frequently split or flaked by frost and other physical agencies, the products being weathered down to a fine sand that may effervesce with HCl and that accumulates in places where the slope is not too steep. Even this "soil" may be entirely barren, although generally where the surface is sheltered by large chunks of rock a few small tufts of mosses or occasional higher plants are to be found—especially *Saxifraga oppositifolia* and to a lesser extent *Salix arctica*. Nevertheless, plants rarely if ever play an important part in stabilizing the general surface—in marked contrast with the situation farther south and on some less active slopes.

These dynamic screes generally form an angle of at least 35 degrees with the horizontal; where they are less steep they tend to be more stable and correspondingly better vegetated. The size and mode of disintegration of the component material varies greatly from place to place, depending not merely upon the origin and type of the rock but also upon local environmental conditions. Slopes with a northerly aspect tend to be more snow-bound and barren than others; in some places the whole side of a hill or valley will be covered with loose scree material.

The darker screes of granitic origin, although they tend to be less dynamic, may also be almost barren. Generally, however, they are better vegetated than those of more rapidly weathering material. Thus, the larger blocks of rock frequently support numerous and quite obvious individuals of *Rhizocarpon geographicum* and *Gyrophora proboscidea*, whereas the occasional patches of mineral earth accumulated in their shelter are sometimes bound for as much as a square metre in extent by *Saxifraga oppositifolia* or *Salix arctica*, or sometimes by other phanerogams.

Where there is almost complete stability—as for example on or below rocky crags—plants may be enabled to take a hold and sometimes darken the surface quite obviously. Thus on one granitic crag at an altitude of 700 feet (213 m.), whose crevices were largely filled with light-coloured sand accumulated from the weathering rocks above, the following were noted:

SPERMATOPHYTA	*Saxifraga oppositifolia*	a	chief plant
	Cerastium alpinum	f	still flowering
	Arenaria rubella	o	
	Papaver radicatum	o	
	Poa arctica	o	
	Draba nivalis	r–o	
	Carex nardina	r	
	Draba alpina	r	
	Saxifraga cernua	r	
	Carex misandra	vr	sterile
	Lychnis apetala	vr	
	Salix arctica	vr	
	Saxifraga caespitosa	vr	
MUSCI	*Distichium capillaceum*	f	
	Ditrichum flexicaule		
	Hypnum revolutum		
	Myurella julacea		
	Pohlia cruda		
	Rhacomitrium lanuginosum		
	Timmia austriaca		
LICHENES	Almost all of the species listed from the plateau above		
FUNGUS	*Melampsora bigelowii* parasitic on *Salix arctica*		

(iii) LOWLANDS

The gently sloping plains that lie at the back of the cove are occupied, as has been noted before, by outwashed morainic material partly covering and partly mixed with marine deposits. On and near steeper slopes, especially, solifluction has evidently been active. Slight ridges indicating raised beaches are to be seen in some places, but generally these have become levelled to an even slope. The surface, most notably near the sea, consists partly of stream beds which are nearly or quite dry in late summer (cf. Plate IV), but which earlier in the growing-season are occupied by torrents of snow- and ice-water from the glaciers. These beds are largely barren, and are noticeable from afar as light-coloured streaks dissecting the darker, stabilized "barrens" that occupy most of the open part of the valley. Near the sea the beds tend to open out into wide "fans".

PLATE IV

Vegetated "islet" in open stream-bed that has dried up in late summer. The darker, flat areas seen in the middle distance are *Saxifraga oppositifolia* "barrens". Craig Harbour, Ellesmere, Sept. 16, 1934.

The chief community of the valley bottom, occupying most of its area, is the *Saxifraga oppositifolia* "barren" developed where the surface is gravelly and static. The snowfall is light and most of the snow drifts into the stream beds and depressions behind ridges, leaving these slightly raised banks and flats largely bare in winter. The surface is dark in colour, due to the "dominant" *Saxifraga oppositifolia* and to the presence of numerous lichens of poor growth, but no humus has accumulated and no real advance has been made by the vegetation. Nevertheless, the stones are generally packed into the surface instead of being loose. Many of the lichens grow on the larger pebbles, although the grey-brown mineral "soil" between these may support stunted examples of

terricolous species. The only appreciable organic content of the "soil", besides living roots and rhizoids, is a little fibrous or other almost intact dead matter. The pH near the surface was 7·0 wherever it was tested.

Saxifraga oppositifolia is always the most characteristic plant of these areas, although in the more favourable situations, such as slight depressions behind ridges, it may be much mixed with *Carex nardina* and *Dryas integrifolia* or, in the most sheltered spots of all, with *Cassiope tetragona*. Typical areas gave the following composite list of higher plants:

Saxifraga oppositifolia	f-va	
Carex nardina	o-a	
Luzula confusa	o-a	
Dryas integrifolia	r-la	
Festuca brachyphylla	f	
Papaver radicatum	f	
Cerastium alpinum	r-f	
Salix arctica	r-f	
Saxifraga caespitosa f. *uniflora*[1]	r-f	
Cassiope tetragona	lf	
Epilobium latifolium	lf	
Arenaria rubella	o	
Carex misandra	o	
Draba alpina var. *nana*	o	
D. subcapitata	o	
Luzula nivalis	o	
Stellaria longipes	o	
Poa abbreviata	r-o	
Potentilla vahliana	r	
Saxifraga nivalis	r	
Silene acaulis var. *exscapa*	r	tussocks up to 35 cm. diam.
Poa arctica	casual	
Saxifraga cernua	casual	
S. flagellaris	casual	

Mosses are little in evidence, but numerous lichens occur and, although they do not nearly cover the surface, contribute markedly to the dark colour and stability of the ground. Most notable are the small Gyrophoras growing on the stones. In the less sparsely vegetated situations, light-coloured species such as *"Ochrolechia tartarea"*[2] are also plentiful—*See* Plate V, which further shows a plant of *Dryas* pressed flat against the ground and drastically eroded on the windward side. In the least vegetated and most exposed places near the sea (from which much of the area has probably been raised only in comparatively recent years), the barrens are very much poorer. Sometimes no higher plants are to be seen, although generally there are at least a few tiny tufts of *Saxifraga oppositifolia* and *Carex nardina* to every few square metres, with or without an occasional plant of *Papaver radicatum* and *Luzula confusa*.

(iv) MARSH

In contrast with their reported abundance on the west coast of Ellesmere, marshy communities were very few and limited in area around Craig Harbour. Indeed only one closed marsh of any considerable extent, dominated by *Eriophorum angustifolium, Arctagrostis latifolia,* and Carices in the manner generally seen in the south, was encountered in my 2 days' wandering in 1934 and 1936. Although there was more silt than moss between the higher plants, the whole formed a fairly close sward. Nevertheless, the growth of the dominants

[1] I.e., *S. caespitosa* subsp. *eucaespitosa* f. *uniflora* (R. Br.) Engler & Irmscher—*See* footnote (3) on p. 12.

[2] Concerning this complex, *See* Part II, pp. 344-5.

was poor and few individuals appeared to have flowered. There was absolutely no peat deposition and even very little humous accumulation, although in places small mossy hillocks up to 25 cm. high were developed. The reaction of the

PLATE V

Mixed "barrens": the prevailing winds come from the right. The *Dryas* axes on this side are pressed flat against the ground, have their bark worn away except on the lower surface, and show signs of life only to leeward. On the left are tufts of *Carex nardina* similarly flattened, their windward side being lifeless and often eroded away or colonized by light-coloured lichens. Craig Harbour, Ellesmere, Sept. 16, 1934.

soil water approximated everywhere to neutrality. Two 2-metre quadrats, taken from areas that transpired to be almost identical in floristic composition, gave the following composite list:

VASCULARES	*Eriophorum angustifolium*	a-vad[1]	
	Carex aquatilis var. *stans*	o-a	
	Arctagrostis latifolia	f	
	Carex membranacea	f	
	Polygonum viviparum	f	
	Salix arctica	o-f	
	Juncus biglumis	r-f	
	Equisetum variegatum	o	
	Pedicularis hirsuta	o	
	Carex misandra	r-o	
	Dryas integrifolia	r-o	
	Alopecurus alpinus	r	
	Lychnis apetala	r	
	Poa abbreviata	r	
	Saxifraga oppositifolia	r	seedlings
	Eutrema edwardsii	vr	

[1]Up to 20 cm. high. The tallest plants seen anywhere around Craig were specimens of *Alopecurus alpinus* growing on disturbed (manured?) plots near the R.C.M.P. detachment, which in some cases reached a height of 35 cm.

Lichens were generally absent, but mosses grew well although varying from place to place. *Orthothecium chryseum* was the most noticeable, but a considerable number of other species were in evidence, of which the following were the most important:

Distichium capillaceum	*D. revolvens*
Ditrichum flexicaule	*Orthothecium rufescens*
Drepanocladus brevifolius	*Haplodon wormskjoldii*
D. intermedius	*Timmia norvegica*

(v) SNOW EFFECT

In slight depressions and other sheltered places where snow accumulates sufficiently to form a good protective covering in winter (as opposed to deep drifts that drastically reduce the growing-season by their late melting), a postclimax community dominated by *Cassiope tetragona* is developed. The most characteristic habitat is the angle below a slight ridge or gravel bank, a prerequisite being that the subsoil shall remain damp even if it is fairly well drained and has the surface parched in late summer. The *Cassiope* so darkens the area that very slight irregularities in surface topography may be accentuated and made visible from afar—cf. Plate VI, which shows a narrow strip of *Cassiope* in the angle of a bank on the *Saxifraga oppositifolia* barrens. Plate VII shows a still closer restriction of the heath to the cracks separating large polygonal areas delimited presumably by frost action (cf. Polunin 1934, pp. 352 *et seq.*).

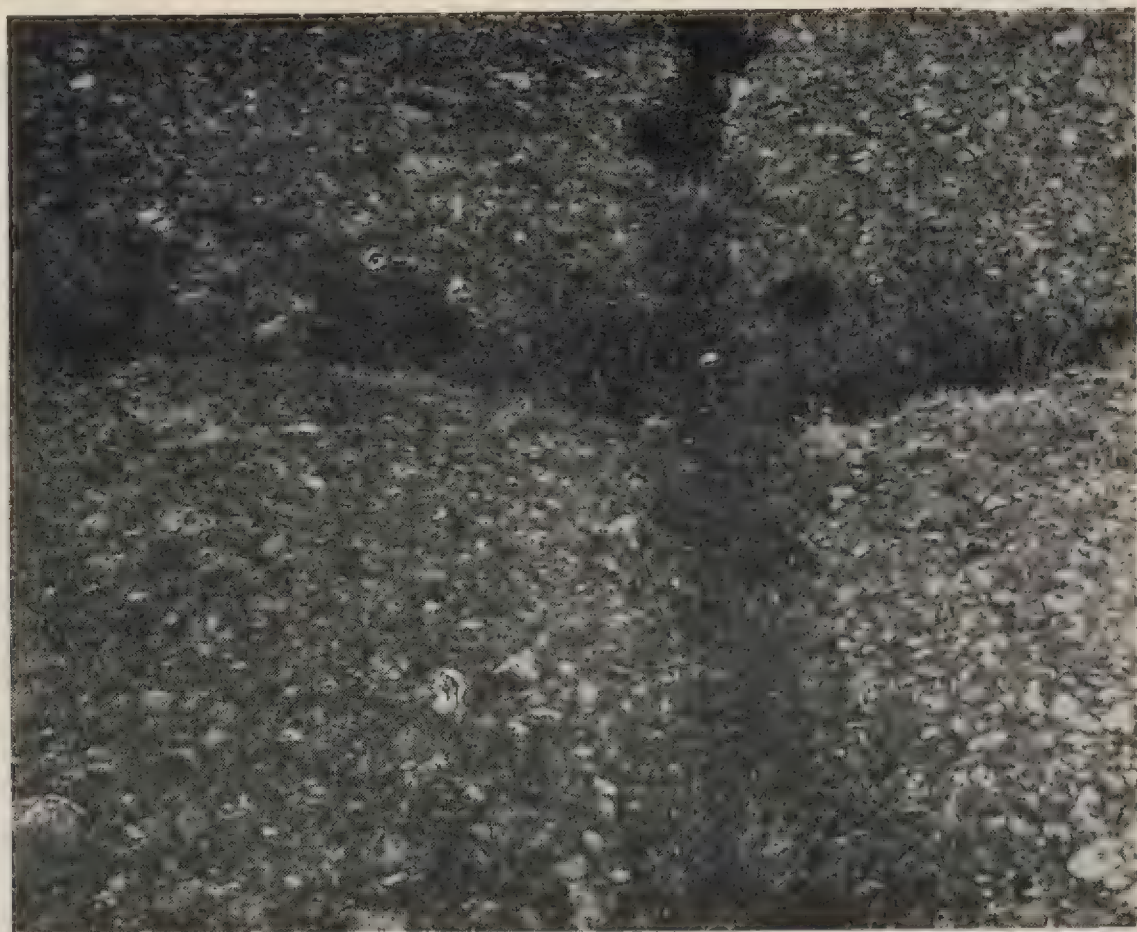
PLATE VI

Narrow strip of *Cassiope* postclimax in angle of slight bank in *Saxifraga oppositifolia* "barrens". Similarly darkened banks are seen in the middle distance. In the background, a glacier descends into the valley on the right and on the left the dark granitic slopes are capped by light-coloured dolomites. Craig Harbour, Ellesmere, Sept. 17, 1934.

A more extensive belt of *Cassiope* heath than either of those figured gave the following list from a small area; not only did the dominant darken the whole aspect but the surface between its shoots was generally dark brown with loose dead leaves and other plant debris, although there was no real humus deposit. The soil beneath the surface was light coloured and gritty; nevertheless the reaction was distinctly, if only slightly, on the acid side of neutrality (pH 6·2). The *Cassiope* grew 8 cm. high at most and in places was completely closed, although in others it was much interrupted by projecting stones (on which grew many of

the lichens of the surrounding *Saxifraga oppositifolia* barrens), or by "open" areas supporting the peculiar hepatic *Gymnomitrium corallioides* or relatively luxuriant

PLATE VII



Cassiope heath lining cracks separating polygonal areas of *Saxifraga oppositifolia* "barrens". Carices and Luzulæ are also in evidence. Scale given by sheath knife with handle 4 inches (10 cm.) long in centre of cross. Craig Harbour, Ellesmere, Sept. 17, 1934.

but much mixed mosses and lichens. The result was a very considerable cryptogam flora, as is indicated in the following list:

VASCULARES	*Cassiope tetragona*	vad
	Carex misandra	o-la
	Dryas integrifolia (including f. *intermedia*)	o-la
	Luzula nivalis	f
	Sagina intermedia	f
	Polygonum viviparum	c-f
	Arenaria rubella	o
	Hierochloe alpina	o
	Luzula confusa	o
	Lycopodium selago	o
	Salix arctica	o
	Papaver radicatum	r-o
	Stellaria longipes	r-o
	Cerastium alpinum	r
	Oxyria digyna	r
	Poa arctica	r
	Potentilla hyparctica (P. emarginata var. *typica)*	r
	Saxifraga nivalis	r
	S. oppositifolia	r
	Draba fladnizensis	vr
	Saxifraga stellaris var. *comosa*	vr
	Silene acaulis var. *exscapa*	vr
BRYOPHYTA	*Gymnomitrium corallioides*	lva
	Rhacomitrium lanuginosum	f-a
	Aulacomnium turgidum	f
	Dicranum groenlandicum	
	Drepanocladus revolvens	
	Pogonatum urnigerum	
	Polytrichum alpinum	

LICHENES	*Stereocaulon alpinum* (incl. with parasite?)	la	
	Cetraria nivalis	la	towards top of bank
	Alectoria nigricans		
	A. ochroleuca		
	Candelariella placodizans		
	Cetraria crispa		
	C. delisei		
	Cladonia cf. *coccifera*[1]		
	C. pyxidata[1] and var. *pachyphyllina*		
	C. uncialis		
	Dactylina arctica		
	D. ramulosa		
	Lecanora epibryon		
	Lopadium muscicolum[1]		
	Ochrolechia frigida		
	Peltigera aphthosa s.l.[2]		
	Pertusaria coriacea		
	Rhizocarpon geographicum		
	Sphaerophorus globosus		
	Thamnolia vermicularis		

Depressions where the snow drifts deeply and lies until late summer, thus reducing the growing-season to a very few weeks[3] during which the surface generally remains damp and the soil just beneath it permanently frozen, were encountered over and over again around Craig Harbour. Indeed, the whole district has its flora and vegetation limited by the shortness of the summer to more or less high-arctic types. The result is that the characteristic "late-snow" flora of these persistent snow patches, consisting of species that can vegetate quickly, differs from that of the exposed surrounding areas much less in Ellesmere than in most places to the south, as the following list of the chief angiosperms occurring on one such patch will indicate:

Phippsia (*Catabrosa*) *algida*	f	
Saxifraga cernua	f	
S. oppositifolia	f	vegetative only
Arenaria rubella	o	
Cerastium alpinum	o	
Luzula confusa	o	
Saxifraga rivularis	o	
Cochlearia (seedlings)	r	
Draba fladnizensis s.l.	r	
Poa arctica ? (sterile)	r	
Saxifraga caespitosa	r	
Stellaria longipes	r	

The community was sparse and growth very poor, although most of the species listed had managed to flower and some individuals had ripened fruit successfully. The lack of any appreciable humous deposit suggested that the glacier, near the end of which the area listed was situated, may only during the previous few years have receded from the patch, although the dark investment of cryptogams in some exposed places even nearer the glacier made this seem very doubtful.

Cryptogams were little in evidence in the area listed, even if small tufts of terricolous mosses and a few lichens contributed to the darkness of the surface. Even large rocks were generally devoid of crustaceous lichens toward the centre of the snow patches. However, farther out where the snow melted earlier and

[1] Field notes only—not recorded in Part I or Part II of the present series. The same is true of some other (usually widely inclusive) items in this work.

[2] *See* Part II, p. 313.

[3] Writing principally of the Canadian Western Arctic and Subarctic, where admittedly the climate is of 'continental' type with relatively hot summers, A. E. Porsild (1937, p. 135) states that *Saxifraga oppositifolia*, *Draba alpina*, and *Papaver radicatum* "require only one month to commence growth, flower, and mature seed."

the growing-season was consequently longer, although still too short to allow *Cassiope* to become established, the flora both of cryptogams and phanerogams was much larger, the latter including all of the above twelve species and, in addition, the following:

Braya purpurascens var. *dubia*
Cerastium regelii
Draba subcapitata
Eutrema edwardsii
Luzula nivalis
Oxyria digyna
Papaver radicatum
Puccinellia vahliana
Sagina intermedia
Saxifraga nivalis

(vi) SPECIAL LOCALIZED HABITATS AND COMMUNITIES

Besides the heathy, marshy, and "late-snow" areas already described, there are some other "special" habitats of more local occurrence that seem worthy of mention. One of these is to be found in the open (and in late summer generally dry) stream beds in the plains near the sea (*See* page 24). Here occasional small islands are left to support communities that may be closed although their composition is very variable, depending it seems largely on chance dispersal. One such "islet" is seen in Plate IV. Although it was only a few square metres in extent, it supported at least several individuals of each of the following angiosperms:

Luzula confusa	lvad
Epilobium latifolium	lad
Festuca brachyphylla	la
Papaver radicatum	f
Saxifraga oppositifolia	f
Cerastium alpinum	o
Saxifraga cernua	o
S. nivalis	o
Arenaria rubella	
Draba fladnizensis	
D. nivalis	
Polygonum viviparum	
Sagina intermedia	
Saxifraga caespitosa subsp. *eucaespitosa* f. *uniflora*	

These higher plants were of good growth and had almost all flowered. Between them were patches of pebbles or coarse sand that were generally bare although tufts of *Distichium inclinatum* and *Polytrichum* sp. were sometimes to be found, with or without *Stereocaulon rivulorum*, *Parmelia subobscura*, and *Ochrolechia frigida*.

Another community of very limited extent but striking appearance even from afar, owing to its orange colour, is that dominated by the lichen *Caloplaca elegans*. This species forms a luxuriant investment sometimes undisturbed by any other, although generally *Gyrophora vellea* and the moss *Aulacomnium turgidum* are also much in evidence. The situation is usually a slight muddy depression, and the whole gives forcibly the impression of being nitrophilous. But how this could be so I do not understand, for the community was encountered in full development in the valley sometimes far from any cliffs or other possible nesting sites,[1] and an approximation to it was even seen on the plateau. In all cases it seemed to be associated with the drainage into (or perhaps seepage out of) the ground of water during much of the summer.

[1] There are no real "bird-cliffs" around Craig Harbour, although small numbers of glaucous gulls, etc., nest in the vicinity every summer.

Finally, some mention should be made of raised beaches, although owing to local disturbances they are much less in evidence at Craig than at most other points on the south coast of Ellesmere. The examples investigated supported one or another of the above described plant communities: the more exposed being poor *Saxifraga oppositifolia* barrens or at best *Dryas*-rich areas, whereas in favourable and snow-covered angles there was developed a more luxuriant, heathy community dominated by *Cassiope tetragona.*

PLATE VIII

Relatively luxuriant mixed heath and marshy vegetation disturbed by patches of gravel and boulders. Craig Harbour, Ellesmere, Sept. 16, 1934.

It will be clear from the above that, in contrast with the situation reported for the southwest of the land, areas of properly closed vegetation are rare and very limited in extent around Craig Harbour; more frequent are mixed heathy or marshy areas disturbed by patches of gravel or boulders (cf. Plate VIII).

(vii) FRESHWATER

Freshwater habitats are also, for a high-arctic land area, unusually limited around Craig Harbour. No lake or other major body of standing fresh water was encountered; indeed, although much of the valley appeared to be inundated for a brief period in early summer, the more lasting freshwater communities to be seen in September were limited to small pools and trickles of water below melting snow patches or in streams that had largely dried up (cf. page 24).

Even this water was generally frozen solid when I visited the area, rendering the collection of Algae rather difficult.

Many pools or eddies in these stream beds appeared to be quite barren, although some supported filamentous and other Algae such as *Zygnema* sp. (sterile), *Cosmarium curtum,* and *Phormidium retzii.* The last named also

forms a scum on damp earth in many places. Other persistent freshwater pools in stream beds had deposits rich in diatoms, the following being identified from one small sample taken in the first week of September, 1936:

Achnanthes flexella
Amphora ovalis var. *pediculus* and var. *typica*
A. triundulata
Ceratoneis arcus
Cyclotella antiqua
Cymbella angustata var. *hybrida* and var. *linearis*
C. botellus
C. scotica var. *incerta*
C. tumidula
C. ventricosa var. *genuina* and var. *semicircularis*
Denticula tenuis var. *intermedia*
Diatomella balfouriana
Diploneis oblongella var. *ovalis*
Eunotia fallax var. *typica*
Navicula amphibola
N. bacillum
N. capitata var. *hungarica*
N. cincta var. *angusta*
N. cryptocephala
N. lanceolata
N. minima var. *typica*
N. muralis
N. perpusilla
N. radiosa var. *genuina*
N. rotaeana
N. vulpina
Neidium iridis var. *majus*
N. longiceps
Nitzchia amphibia
N. amphioxys
N. clausii
N. commutata
N. palea
Pinnularia brebissonii var. *genuina*
P. divergens var. *genuina*
P. divergentissima var. *typica*
P. microstauron
Stauroneis anceps var. *amphicephala*
Synedra amphicephala
Tabellaria fenestrata
T. flocculosa

Where dry the beds were usually barren, owing to the washing down and general disturbance every summer. Thus, there were often no plants of any kind to be found in areas of many square metres, although generally a thin investment of such Algae as *Oscillatoria tenuis* was to be found on the undersides of stones. On the other hand, where the bed opened out and became sandy instead of bouldery there was often a fair growth of mixed mosses, almost all in the vegetative condition. The following were collected in the dry bed of one such stream in the open plains near the sea:

Calliergon sarmentosum
C. stramineum
Distichium capillaceum
Drepanocladus brevifolius
D. revolvens
Minium hymenophylloides
Philonotis tomentella

More rare were phanerogams, although in one place or another I saw in these stream beds almost all of the species listed on page 30 from the well-vegetated "islet", and also *Lychnis apetala, Salix arctica, Saxifraga rivularis,* and *Silene acaulis* var. *exscapa.* These are all plants of more or less dry land; indeed there are, so far as is yet known, no exclusively aquatic vascular plants in the Ellesmere flora.

(viii) STRAND AND MARINE

The tide range is small (some 3-4 m.) and the shore hereabouts shingly and almost entirely barren in spite of the relatively sheltered situation. In summer it is generally strewn with stranded ice-pans (*See* Plates I and III), whose grinding action must contribute materially to the barrenness of the shore between and around the tide-marks. However, in places where the shingle banks are broken by streams or muddy flats, there occur depauperated "saltmarsh" communities dominated by *Puccinellia phryganodes,* with associated *Stellaria humifusa* (and in drier places *Cochlearia officinalis* var. *groenlandica* and *Carex maritima*), but none of the other plants that are to be found in such habitats almost everywhere to the south.[1] Growing macroscopic Algae are also generally absent between the tide-marks, although an abundance of detached algal material may afford a habitat for numerous epiphytic and other microscopic types. However, *Fucus vesiculosus* of fairly good growth may occur on rocks in sheltered situations. Elsewhere, even if it does occur, the *Fucus* is generally reduced to close bobbles by the grinding action of ice (cf. Polunin 1932a, p. 230, and 1935, p. 188).

Even for some distance below low tide-mark the growth of the Algae tends to be poor, but farther down dense beds of *Laminaria*[2] and *Alaria*[2] spp. are to be seen, accompanied by a host of smaller types. Truly in the Far North it is in the sea rather than on land that life flourishes.

(2) DEVON, CORNWALLIS, AND SOMERSET ISLANDS

This is a rather ill-defined group, which for our purposes has been made to include Graham, Buckingham, North Kent, and Coburg Islands, but to exclude Griffiths and some other minor accompaniments of Cornwallis Island. The district thus constituted extends from about 77° 20′ N. southwards to 72° N., and from about 78° 30′ W. to 97° 30′ W. The largest unit, having an estimated area of 20,484 square miles (Bethune 1935, p. 16) and comprising more than half the land, is Devon Island. This considerable but irregular land-mass, previously called "North Devon", stretches from latitude 74° 30′ N. to latitude 77° 5′ N., and from longitude 79° 30′ W. to longitude 97° W. Like Ellesmere, Devon Island "shows its boldest face to the eastward", where there is a table-land having an elevation of some 3,000 feet (914 m.), which gradually loses height farther westward and ultimately gives way to low coastal plains in the southwest. The island has been intermittently inhabited in recent years, there being a "post" at Dundas Harbour on the south coast.

In the eastern parts of Devon Island the coasts are rather rugged as well as high, with numerous cliffs and mountains separated by glaciers which at frequent intervals come right down to the sea. However, the mountains are generally rounded, such peaks as I have observed being rather low and near the sea, and probably due to secondary erosion. No major nunataks were seen. Inland is

[1] Thus, *Elymus arenarius, Mertensia maritima, Arenaria peploides, Carex salina,* etc., appear to be absent from Ellesmere, where even *Carex ursina* is restricted in distribution.

[2] *See* footnote (1) on p. 29.

a continuous, domed ice-cap reminiscent of that of Greenland, and said to be some 90 miles in extent in any direction. It starts in most places near the coast at altitudes not much above 1,000 feet (305 m.) and may exceed 4,000 feet toward its centre, leaving very little of this eastern part of the island ice-free. Indeed the coastal areas around are mere rocky bluffs or plains of small extent; a notable exception to this is Philpots Island on the east coast, whose "centre is a swampy plain, with numerous streams and lakes, interspersed with ranges of low hills" (Dickie 1871, p. 32).

The smaller islands associated with Devon Island are rather various, as will be explained below; North Kent and Coburg are the most notable, both being high and rugged and largely ice-bound inland.

To the west of Devon Island lies Cornwallis Island (latitude 74° 40′ to 75° 35′ N., longitude 94° to 97° 30′ W.). Its western extremity is the most westerly point in our area. Then, farther south, comes the very considerable Somerset Island, which extendes from latitude 72° N. to latitude 74° 10′ N., and from longitude 90° W. to longitude 96° W. Cornwallis Island has an area of some 2,592 square miles (Bethune 1935, p. 16), and Somerset Island an area of approximately 9,540 square miles (Bethune *l.c.*). Both are on the whole lower and less rugged than Ellesmere and Devon Islands, although their shores or coastal plains are generally bordered by cliffs or other steep slopes not less than 400 feet (122 m.) high, and the interior plateau, especially in the limestone districts, tends to be undulating and much dissected by deep valleys or ravines which considerably impede travel.

GEOLOGY

Like the flora, the geology of the islands comprising our second district is in many places less known than that of Ellesmere, in spite of the more northerly situation and relative inaccessibility of most of the latter. This says much for the adventuring spirit in man; but in any case a few general notes, gleaned from various sources, will suffice for our present purpose.

As far as has been determined, the main body of Devon Island is built up of Lower Palæozoic, non-coal bearing rocks that are principally limestones or dolomites. The eastern parts of the island, however, comprise a dark, granitic and gneissic assemblage of much the same type as that occurring in the adjacent, southeastern parts of Ellesmere. To the west this assemblage is overlain by light-coloured limestones and sandstones that appear to dip to the westward so that they compose most of the surface in the western half of the island even around sea-level. On the west coast the cliffs, which are often low, are generally of Silurian limestone; the northwestern peninsula, however, is of Upper Palæozoic rocks. It is underlain by a continuation of the Devonian sediments that are found in the southwestern extremity of Ellesmere (*See* above).

In Norwegian Bay to the north of Devon Island lie Graham and Buckingham Islands, which are built up of Mesozoic rocks, and, farther south, the more extensive North Kent Island. The southern part of the last-named is built of Silurian limestone "of the better, less siliciferous kind" (Simmons 1909, p. 18), although in the north there is much sandstone. The small Castle Island and Devils Isle, which lie close to the coast of Devon Island farther south in Lancaster Sound, are both composed entirely of limestone; on the other hand, the little known Coburg Island appears from the sea to be made of darker, granitic rocks in conformity with the adjacent parts of both Ellesmere and Devon Islands.

The much larger Cornwallis and Somerset Islands are less easily disposed of; for, whereas both are predominantly of Lower Palæozoic (mainly limestone) rocks similar to those forming the main body of Devon Island, the northwestern extremity of Cornwallis Island consists of Upper Palæozoic deposits, most notably Carboniferous sediments, and most of the west coast of Somerset Island is composed of granites and gneisses. Thus, of the total area of land surface in district 2, perhaps seven-eighths are occupied by more or less light-coloured limestones, dolomites, or sandstones, and the remainder by darker, granitic rocks.

CLIMATE

The climate of Devon Island appears, from such data as have been available, to be on the whole rather similar to that of southernmost Ellesmere, as is to be expected from their geographical proximity. Thus the following table, showing the more significant details of temperature and precipitation for 2 years at Dundas Harbour on the south coast, compares rather closely with a similar table made at Craig Harbour on the south coast of Ellesmere (page 9), although the observations in the two places were made at different times. But

Month	Temperature °F.			Average 1931-2 Precipitation	
	Max.	Min.	Monthly mean	Total inches	Rain or snow
Dundas Harbour, 74° 35′ N., 82° 10′ W.					
January	3	−36·5	−18	0·09	S
February	3	−43	−24·5	0·12	S
March	24	−39	−10	0·55	S
April	23	−28	−1	0·25	S
May	41	− 3	22	0·31	S
June	50·5	24	36	0·98	S and R
July	59·5	30·5	43	1·14	not stated, but presumably all rain.
August	53	28·5	39	1·85	
September[1]	46	22	31	0·66	S and a little R[1]
October	32·5	− 5	16·5	1·99	S
November	23·5	−24·5	− 2	0·89	S
December	12	−31	−10·5	0·28	S

[1] 1932 only.

even as conditions at Craig Harbour were on the whole less inimical than at Bache Peninsula and elsewhere to the north in Ellesmere, so the climate farther south at Dundas Harbour is rather more favourable than at Craig. Thus, the precipitation may be slightly heavier at Dundas, though still under the "10 inches per annum minimum for better-than-desert conditions" (in hot countries); and it is even more concentrated into the summer and adjacent months, almost five-sixths of the nearly 10 inches (254 mm.) falling in the 6-months' period May to October during the years under review, and thus ensuring not only a fair supply of water during the growing-season but also a goodly covering of snow from the beginning of winter, at least in the more favourably sheltered situations.

More significant, probably, from the biological point of view are the temperature relationships. That the winter tends to be about as cold as in southern Ellesmere is probably of little significance; a few degrees difference during the period of dormancy do not mean much to properly acclimatized, hardened biota. It is rather the slightly but distinctly higher summer tem-

peratures in Devon Island that seem likely to be most significant in allowing the persistence there of relatively southern plants and the development sometimes of quite luxuriant vegetation. It must, however, be remembered that Devon Island appears to be in the "Banana Belt" only to the inhabitants (when there are any) of Ellesmere; it is still a fairly high-arctic land where the temperature scarcely ever reaches 60°F. (15·6°C.), and where snow and frosts can occur at any time of the year—indeed there seems scarcely ever, anywhere in the district, to be a month without at least one fairly severe frost.

It is common experience almost the world over that weather conditions vary considerably from place to place, even within limits of a few miles. The Arctic, including the present district and others surrounding it, is no exception. Nevertheless it appears that, if we ignore local variations due to such factors as changes in exposure, the climate in other parts of district 2 is much the same as at Dundas; at least, that is my impression from a perusal of various old expedition records. The chief difference is that the places to the south and west, e.g., Somerset Island and its environs, have a slightly more continental climate than has Dundas Harbour; they certainly tend to have a colder winter, with a January mean below –20°F. (–28·9°C.), and they also may have a warmer summer, even if the characteristic July mean throughout district 2 is between 40° and 45°F. (cf. Connor 1930, map on p. 8).

VEGETATION

The vegetation of the islands off the north coast of Devon Island has been reported upon by Simmons (1909, pp. 10-21), who investigated several of them. Thus, Graham Island (latitude 77° 10-20′N., longitude 90°40′ to 91°6′W.) and the smaller associated Buckingham Island (latitude 77° 10′ N., longitude 91°20′W.) being "of Mesozoic rocks, which may have afforded soil favourable enough for the development of a dense vegetation . . ." are indeed reported by Schei (in Simmons 1909, p. 21) to support "a well developed vegetation . . ., even if the species are probably few".

North Kent Island (latitude about 76° 27-51′ N., longitude 89°45′ to 90°35′ W.), visited twice by Simmons, is noted by him as having much poorer flora and vegetation than the adjacent parts of Ellesmere that show a similar geological character, probably due to "The fact that it is more difficult for plants to reach the convenient growing-places. . . ." (Simmons 1909, p. 19). "Barrens" of *Saxifraga oppositifolia* with relatively few and exclusively high-arctic associates appear to occupy most of the ice-free area, especially on the predominant plateau, which seems in many respects to be like the plateau area investigated at Craig Harbour (*See* pages 20-21), even if "in some parts . . . mosses were unusually predominant", so that Bryhn (1906, pp. 211-3) lists over fifty different Bryophyta collected by Simmons during his short excursions inland. Simmons further notes (1909, p. 20) that "Lichens also occurred in great abundance, both those that form crusts on the stones, and the large earth-lichens of bushlike genera, such as *Cladonia, Cornicularia, Cetraria* and others . . .". What appears to have been the richest vegetation by far was concentrated around where numerous birds nest, viz., about the high headland that forms the northeastern extremity of the island. Thus, Simmons writes (1909, p. 20), "In general, the flowering plants appeared in single tufts or individuals in the open, bare ground; only *Alopecurus* formed a denser vegetation in some small, boggy depressions, and *Catabrosa*[1] along the brooklets which were also bordered with mosses interspersed with some flowering plants such as *Ranunculus nivalis, Draba alpina* var. *gracilescens, Luzula nivalis.*"

[1] *Phippsia.* (N.P.)

The small limestone Castle Island (latitude 76° 10′ N., longitude 89° 20′ W.) has its low cliffs, terraces, and limestone debris, and even small patches of clay, largely barren except where manured by sea birds; even there the vegetation is mainly of cryptogams, phanerogams being few and limited to about a dozen high-arctic species (Simmons 1909, p. 10). The "little rock" called Devils Isle (latitude 76° 29′ N., longitude 90° 40′ W.) is of less hard limestone "with less silicate and more clay", although this again "would form still a very poor soil were it not inhabited by rather many birds" (Simmons 1909, p. 12). Again phanerogams are very few, the vegetation even in manured areas, which may have a more or less continuous investment where water trickles down from snow-drifts, consisting largely of lichens and mosses. Between thirty and forty Bryophyta were collected on this rock by Simmons (cf. Bryhn 1906, pp. 251-3).

Concerning these two islets Simmons writes (1909, pp. 12-13) that they "have risen above the surface of the sea at a rather late period . . . ." and . . . . "show a considerably poorer flora than that of the mainland[1] localities under similar conditions. . .". The same author concludes (*l.c.*, pp. 14-18) that birds have been responsible for dispersal to the islets of most of the phanerogams and several of the mosses (i.e., those that are not known to fruit in these regions), the birds probably bringing the plants not casually but as nest-building material over the mile or two from the mainland.[1] To these islets, dispersal on floating ice was probably prevented by their high perennial ice-foot, although in other places, where currents are less strong and the sea is ice-bound for the greater part of the year, "wind transport over the snow-covered ice in winter. . . " probably . . . "plays a prominent part in the migration of arctic plants" (cf. also Ridley 1930, pp. 11-12 and 175-6).

Of Coburg Island (latitude 75° 35-55′ N., longitude 78° 30′ to 79° 30′ W.) Sverdrup (1904, I, p. 209) says "we were not able to discover a single green spot", and Mr. Robert Bentham reports (*in litt.*) that it is generally similar to the rather barren, adjacent shores of southeastern Ellesmere "although a certain amount of vegetation grows on the site of the old Eskimo settlement a few miles north of Cape Spenser. Raised beaches are present, but barren—presumably owing to their extremely exposed positions. It might be expected that Coburg Island, being a nesting ground, would support a vegetation comparable with that of Foulke Fiord, Greenland, but erosion and disintegration are proceeding too rapidly to permit the accumulation of soil."

Notes from various points on the north coast of Devon Island[2] indicate that the vegetation there is about as variable and locally as luxuriant as on the other side of Jones Sound, which constitutes the south coast of Ellesmere. Indeed, Mr. Bentham compares the two coasts more than once (*See* above, page 16), and so does Simmons (1909, pp. 6-9). Thus, of two points in Viks Fiord (c. 75° 55′ N., c. 91° W.) visited by Schei, the vegetation in one place was said to be "scarce" and in the other "very scanty" (Simmons 1909, p. 6). In West Fiord (latitude 76° 8′ N., longitude 90° 10′ W.) the vegetation was again extremely poor, at least on the low-lying limestone; here "The densest vegetation was found along some small brooks and around some shallow ponds near the shore where, however, mosses decidedly formed the most prominent constituent of the verdure" (Simmons 1909, pp. 6-7). On the other hand, about Cape Vera (latitude 76° 13′ N., longitude 89° 25′ W.) there is to be observed

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[1] I.e., the adjacent coast of Devon Island. (N.P.)

[2] My recent enumeration of the flora of Devon Island (cf. 1940) shows that 104 species of vascular plants are now known to occur thereon.

"a rather dense verdure in some parts of the low foreland in front of the high wall of limestone cliffs. . .", which latter would be "rather poor in plant life were it not that their ledges are apt to be used as a rookery where millions of fulmar petrels breed. Thus the slopes below became abundantly manured, and both the slopes of limestone debris and the inner parts of the foreland are covered with a dense verdure formed, for the greater part, of mosses but also of flowering plants" (Simmons 1909, pp. 7-8).[1] Elsewhere hereabouts the vegetation appears to be rather poor, although Simmons remarks that "On the surface of the snow drifts. . . 'red snow' appeared in greater abundance than I have seen anywhere else; and in the rivulets, on inundated ground and in the ponds many algae, especially blue-green ones, were growing". This was in the middle of July, 1902; the flora as well as the vegetation appeared to be rather poor, except for mosses (Simmons 1909, p. 8).

"East of the large glacier west of Cape Hawes" (latitude 76° 17′ N., longitude 89° 40′ W.) and at Mount Belcher "opposite Devils Isle", both flora and vegetation, at least on the clay and gravel outwash plains, were very poor—cf. Simmons (1909, p. 9), who also notes several times the apparent absence even of Carices and Eriophora, although he says that "Further west towards Arthur Fjord there are, as Captain Baumann told me. . . wide stretches of bogs and grass-grown plains".

Apart, perhaps, from the little known Upper Palæozoic region composing the extreme northwestern Grinnell Peninsula,[2] it is probably in the eastern parts of the island where the rocks are gneissic and granitic that the vegetation is most widely luxuriant. Thus already on the north coast Dr. R. M. Anderson, lately Chief of the Division of Biology, National Museum of Canada, and Mr. R. Bentham tell me that there are low lands between Cape Sparbo (Cape Hardy, latitude 75° 52′ N., longitude 84° W.) and the main scarp that are particularly rich. The ground consists of raised beaches and low, rolling plains of solid rock, with depressions that tend to be boggy and carry a rich vegetation. A contributory factor toward the richness of the vegetation just here is the presence of quite numerous musk-oxen (*See* Anderson 1935, photo on p. 82, which shows continuous marshy pasturage in the foreground, and cf. Wordie 1938, photo facing p. 407, which indicates how very rich may be the vegetation in manured areas hereabouts).

Even more luxuriant is the vegetation of the south coast in these supposedly Precambrian regions. As an example we may take the environs of Dundas Harbour, whose outstanding habitat characteristics and main plant communities are described in some detail below. Mr. Trevor ("Curious") Harwood of Toronto University, who spent 2 years at Dundas as a servant of the Hudson's Bay Company (from 1934 until 1936, when the post was abandoned and all human beings left the island), tells me that Dundas is fully characteristic of the better vegetated parts of the southeastern corner of Devon Island. Mr. Harwood has travelled extensively on the island and has nowhere seen vegetation more luxuriant than that which occurs in the more favourable situations around Dundas Harbour. Even here growth is noticeably poorer on the limestone at the head of the fiord, as is also the case everywhere that he has seen farther west; where in four places during the first 70 miles (113 km.) west of Dundas

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[1] Cf. also Simmons 1904, p. 474.

[2] The west coast, at least, of this may be rather barren, for it is in comparison with it that Osborn (1855, p. 128) speaks of Cape Lady Franklin (which lies to the west, on Bathurst Island) as being "richer in vegetation and animal life"—cf. Belcher 1855.

there are distinct outcrops of the underlying granite, the vegetation is not quite so dense as in favourable situations around Dundas, although generally it is less poor on these outcrops than on the Lower Palæozoic rocks.

The final 100 miles to Beechey Island are, Mr. Harwood tells me, entirely of the light-coloured limestones and sandstones, this region being relatively barren[1] except on some gentle slopes of morainic gravel in the vicinity of Radstock Bay.[2] These slopes are grassy and appear green from the sea in early summer; only here has he seen mosquitoes on Devon Island. On the west coast[3] the limestone cliffs are "astonishingly barren" except where they give way to low plains such as occur around Baring Bay (latitude 75° 40′ N., longitude 92° W.). Here the vegetation is much more appreciable and supports considerable herds of musk-oxen and caribou. Mr. Harwood has also told me of his discovery of an interesting lake about 15 miles (24 km.) east-northeast of Dundas post; it is completely surrounded by some miles of lofty ice-cap, but has on its rocky, ice-free shores a fair abundance of grasses, poppies, etc.

It seems appropriate here to quote the remarks of three experienced arctic travellers, well known in their times for sound observation, concerning rather similarly exposed points spaced along the south coast of Devon Island, as they illustrate the differences characteristic of these regions of different substratum. Thus, Parry (1826, p. 22) wrote of Cape Warrender (latitude 74° 26′ N., longitude 81° 44′ W.) that although "The vegetation was scanty", the ground supported "luxuriant reindeer moss", whereas of a (probably limestone, and certainly Lower Palæozoic) district in longitude 88° 20′ W., Sutherland reports (1852, I, pp. 287-8) that inland "the top of a flat table land is reached . . ." at an elevation of 600 to 800 feet (183-244 m.) "on the border of a slightly undulating and unbounded plain, which is nearly as barren as the sandy deserts of Africa", and of the limestone Beechey Island (latitude 74° 44′ N., longitude 91° 45′ W.) Amundsen (1908, p. 51) remarks " The heaviness and sadness of death hang over Beechey Island. Here is neither life nor vegetation" (cf. also Low 1906, p. 51, Bernier 1910, p. 386, and Kitto 1930, photo on p. 23).

The greater part of Cornwallis Island appears, as its geographical proximity would suggest, to be similar as regards conditions and biota to these southwestern parts of Devon Island.[4] Thus in the region of Assistance Bay (latitude 74° 40′ N., longitude 94° W.) the flora is poor and the vegetation scanty, especially as compared with such less calcareous regions as Melville Island (cf. Sutherland 1852, I, p. 363, and II, p. 194). Also, growth is generally stunted, even compared with points much farther north in West Greenland (cf. Sutherland 1852, II, pp. 293-4), so that "a basketfull [of scurvy-preventing plants] could not be obtained in one or even two hours" (*ibid.*, p. 235, and cf. Belcher 1855, I, p. 341). On the whole, Sutherland, to whom we still owe most of our biological information about this island, was, during his many months sojourn there, more intrigued with such features as "red snow", which he mentions finding several times, with the much more abundant life in the sea, and with the large gelatinous

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[1] Cf. Parry (1821, p. 50).

[2] M'Cormick mentions (1854, p. 221) that hereabouts, at the base of Caswall Tower, "....... are several circular ancient Esquimaux encampments, within which the wild flowers flourish more luxuriantly than in any other spot I met with."

[3] This was explored by M'Cormick (cf. 1854), who does not, however, appear to have had any interest in the vegetation, although he mentions finding *Caloplaca elegans* (sub nom. *Lecanora elegans*) under the snow at Baring Bay (*l.c.*, p. 205).

[4] But not with all parts of Bathurst Island, lying to the northwest, whence Lyall (1855, p. 145) and Osborn (1855, p. 127) have reported relatively luxuriant vegetation. It should be noted that Bathurst Island was at this time supposed to form part of Cornwallis Island. Besides Bathurst Island, Griffiths Island, lying in Barrow Strait, is also outside the area of the present report, although from here again we have been given a few scattered notes on the vegetation (e.g., by King 1852, p. 128). Like parts of the more westerly Melville Island (cf. Parry 1821), Bryam Martin Island, which lies between the southern shores of Melville and Bathurst Islands, appears to be relatively well vegetated in favourable situations (cf. Parry 1821, p. 61).

Cyanophyceae occurring on wet earth,[1] where they were often abundant, than with the more general features of the vegetation, which evidently is almost everywhere very poor.

Finally we come to Somerset Island, previously called "North Somerset", which is the southernmost and second largest unit in our second district, and which is, unfortunately, rather little known botanically, in spite of its situation "on the Northwest Passage" and near[2] the North Magnetic Pole. The first plant collection from there was made by Parry and his officers, to whom we owe the following few remarks on the vegetation of some northern parts of the east coast. Of the vicinity of Elwin Bay, in latitude 73° 27′ N. and longitude 90° 50′ W., Parry reports (1826, p. 100) that "The vegetation in this place was, as usual, extremely scanty, though much more luxuriant than on any of the land near our winter-quarters",[3] and concerning their subsequent visit to Batty Bay, a few miles farther south, he says (p. 101), notwithstanding Ross (1835, p. 711), "We also found a more abundant vegetation than before, and several plants familiar to us on the former voyages, but not yet procured on this." Of "a broad valley facing the sea", along the coast south of Batty Bay, Parry later remarks (1826, p. 104) that in the neighbourhood of some Eskimo stone circles "apparently of very old date, being quite overgrown with grass, moss, and other plants. . . . . . the vegetation was much more luxuriant than anything of the kind we had seen before during this voyage."[4] However, of the northern part of the same east coast about Port Leopold (latitude 73° 49′ N., longitude 90° 14′ W.) McClintock (1859, p. 178) remarks "How astonishingly bare the land looks; it is more barren than Beechey Island"—a sentiment echoed by the late Dr. M. O. Malte, Chief Botanist to the National Museum of Canada, who visited Port Leopold for a few hours in 1927 as a member of the Eastern Arctic Patrol of that year. Meanwhile Markham (1875, p. 178) had pronounced this place "without exception, the most barren and dreary-looking spot it was ever my lot to behold; no sign of verdure anywhere, nothing but sandstone, snow, and ice. Occasionally, in some little sheltered crevice, I came across a bit of green moss or pretty little pink flowers growing in small patches,[5] but not in sufficient quantity to relieve the desolate sterility which everywhere prevailed."

On the other hand McClintock reports (1859, p. 182) of Bellot Strait in the extreme south of the island that "Its granitic shores are bold and lofty, with a very respectable sprinkling of vegetation for latitude 72°. Some of the hill-ranges rise to about 1,500 or 1,600 feet above the sea. The low land eastward of Depôt Bay is composed of limestone, destitute alike of fossils and vegetation." McClintock wintered in Bellot Strait at Port Kennedy (Kennedy Harbour), latitude 72° N., longtitude 94° 30′ W., where he rather naïvely reports (1859, p. 198) "I walked through the most promising valleys for eight hours, but did not see a living creature; yet there is a very fair show of vegetation,[6] much more than at Melville Island"—but not so much, it would seem, as on the mainland only slightly to the south (*ibid.*, p. 184).

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[1] Sutherland reports (1852, II, p. 206) the finding of such colonies on lakes in land ice, and also in Barrow Strait several miles from land, where the same insects were associated with them.

[2] Since this was written it has become apparent that the Pole is actually situated *in* Somerset Island, where we hope to make further observations this summer (1947).

[3] The expedition had wintered at Port Bowen, on the adjacent coast of Baffin, which Parry had earlier described as the most barren spot he had ever seen.

[4] Cf. also Bellot (1855, I, pp. 367-8, and II, pp. 276-7), though his accounts are admittedly naïve.

[5] Most likely, in spite of the designation "pink", *Saxifraga oppositifolia*—*See* Markham 1875, p. 281. (N.P.)

[6] Later on (p. 327) McClintock remarks of the environs of Port Kennedy that "the valleys are respectably clothed with vegetation."

This was my sum total of reasonably reliable information about the vegetation of the island—I purposely do not include the vague remarks of some other explorers—until 1939 when Mr. D. H. Chitty of the Bureau of Animal Populations, Oxford, kindly volunteered to make more intensive investigations for me. He went to Bellot Strait where, a little east of Port Kennedy, at Fort Ross, the Hudson's Bay Company had established a trading post 2 years previously. Most unfortunately the season was well advanced and the ground under snow; nevertheless, with the help of Mr. D. A. Nichols of the Geological Survey of Canada, who had previously visited the spot under more favourable conditions, Mr. Chitty was able to supply me with some notes from which the following points are most apposite: Bellot Strait is flanked by abrupt cliffs penetrated by valleys in many places. These valleys run north and south, in the direction of the backbone ridges that make up the mountainous terrain of the southwestern part of Somerset Island. The eastern part of the island is made up of limestone lying almost horizontally and forms a high plateau with occasional lower plains, especially towards Bellot Strait. Fort Ross is on the granitic, mountainous part facing Depot Bay, the post being located on a peninsula several miles in extent and connected to the mainland of Somerset Island by a tiny isthmus made up of a gravel bar. The ground around the post and inland is very stony; much of it occupied by large boulders piled one on top of another without soil between them; much of it of irregular, frost-shattered stones with very open plant communities closely hugging the ground. *Saxifraga oppositifolia* barrens seem to be the most characteristic type of vegetation, except in low, moist places where sedges and grasses are fairly close and thick.[1] Indeed the vegetation is so scanty that when the ground was lightly frozen and snow-covered it was difficult to find even sufficient vegetable matter to feed a few captive lemmings! Nevertheless, the area is an intensely interesting one, and it is to be hoped that a suitably qualified botanist will soon visit it under better conditions and for sufficient time to make a detailed ecological survey, which at present is lacking from thousands of square miles around.[2]

Plant Communities Around Dundas Harbour

Dundas Harbour is a narrow fiord situated on the south coast of Devon Island alongside the shallow cove at the back of which lies the R.C.M.P. detachment. This latter is situated in latitude 74° 35′ N., longitude 82° 10′ W., and was used by the Hudson's Bay Company from 1934 to 1936 but has otherwise been unoccupied in recent years,[3] the whole island being normally uninhabited except for bears, musk-oxen, and the like. Caribou are said to be almost extinct here, although decaying antlers still litter many of the more luxuriant pastures.

As is the case in the vicinity of Craig Harbour, the topography around Dundas is rugged, the physiography showing drastic changes (cf. Plates IX and X), including dissection by glaciers that in some cases come right down and calve into the sea. The habitats afforded (and the attendant plant communities) are accordingly very variable, and the variability of the geology from spot to spot further complicates the situation.

[1] The abundance of marine shells on the terraces and the presence of the skeleton of a whale at an altitude of about 300 ft. (91 m.) seem to indicate that much of the ground hereabouts has risen out of the sea only in relatively recent times. Is it not possible that the peninsula on which the post is located was still an island in the time of McClintock? His book is no longer available to me, but I seem to recollect that he speaks of a long, low island a few miles southeast of the place which he named Port Kennedy.

[2] At the moment I can only guess that some recent reports from Fort Ross (Raup 1941, pp. 8-10), e.g., of such relatively mesothermic plants as *Betula glandulosa*, *Potentilla crantzii*, *Rhinanthus groenlandicus*, and *Solidago multiradiata*, may be due to an unfortunate mixing of labels or other misunderstanding with the collector (not Dr. Raup himself).

[3] Dundas Harbour was reopened as an R.C.M.P. detachment and weather station in 1945, being at that time the farthest north inhabited locality in Canada (R. A. Gibson, *in litt.*).

At the back of the cove, near the detachment, the rocks consist of light-coloured, garnetiferous gneisses with bands of darker grey and dark reddish gneisses. Up the fiord there are greyish and reddish gneisses capped by a series of sandstones, dolomites, and limestones (cf. Plate XV), some of which effervesce slightly with HCl in the cold. These plains, as is usual in areas adjacent to centres of present-day glaciation, are predominantly of outwashed glacial material underlain by and largely mixed with older glacial material which has been rewashed by marine agencies, and which frequently contains shell fragments and particles of limestone.

An account of the climate has already been given on pages 35-6. Conditions of growth around Dundas are almost everywhere much more favourable than at Craig, the vegetation being correspondingly more luxuriant. The flora is larger and closed communities are much more frequent and extensive. *Papaver radicatum* and some of the grasses and Cyperaceae are frequently seen exceeding 30 cm. in height. Nevertheless, the land is rather high-arctic in type, with patches of old snow persisting throughout the summer right down to sea-level; moreover the ground is liable to be covered with a lasting fall of new snow, often accompanied by "killing" frosts, from early September. On both my visits to Dundas, during the first half of September in different years, it was evident that winter was already at hand; a sprinkling of fresh snow lay almost everywhere until the afternoon and, my visits being necessarily protracted, sadly limited my ability to survey the vegetation accurately and collect the plants efficiently. Even my listing of phanerogams sometimes suffered, and work among the cryptogams was greatly hindered and sometimes prevented altogether. The result is that the following lists frequently omit details of the cryptogams, or, beyond the most characteristic and familiar species, merely mention the few that could be cut out of the frozen matrix and brought home for determination.

In contrast with the situation around Craig Harbour, where plants were so little in evidence that the communities they formed had to be defined primarily by local physiography, vegetation at Dundas frequently takes sufficient hold of the surface to provide a characteristic or at least recognizable "aspect". Eight main headings are again to be recognized, although they frequently overlap with one another and do not always correspond to those distinguished at Craig Harbour.

(i) HILLTOPS AND STEEP SLOPES

Uplands and slopes of one kind or other are, if anything, even more numerous and variable than at Craig, as Plates IX and X suggest. Time did not permit me to investigate the higher levels, but many of the scree and other slopes leading up to them appeared to be similar to those described before from Craig Harbour, although the plants were generally better grown and much more numerous at Dundas.

The rounded top of one exposed hill near the sea supported a poor but characteristic *Saxifraga oppositifolia* "barrens" community, as follows:

Saxifraga oppositifolia f. *pulvinata*	f
Carex nardina	o
Luzula confusa	o
Draba nivalis	r
Hierochloe alpina	r
Lychnis apetala	vr
Salix arctica	(1)
Saxifraga nivalis	(1)

PLATE IX

Looking across a bay east of Dundas Harbour, showing drastic physiographic changes in both lowlands and uplands. A glacier is seen coming down from the ice-cap (upper left-hand corner) and calving into the sea. South coast of Devon Island, Sept. 14, 1934.

PLATE X

Mountain pass to a small marginal tongue of the ice-cap. The slopes and limited flats around are sprinkled with new snow; they are extremely variable in type. Near Dundas Harbour, Devon Island, Sept. 14, 1934.

Rhacomitrium lanuginosum was the only moss that appeared at all common, although the surface was dark with lichens of poor growth, including *Alectoria ochroleuca, Gyrophora* spp., *Parmelia pubescens, Rhizocarpon geographicum, Sphaerophorus globosus*, and *Stereocaulon* sp. Larger lichens appeared to have been blown away and there was no accumulation of humus, but only yellow-brown sand that did not effervesce with HCl. However, just below the summit where the situation was less extremely exposed, the sandy or gravelly material was in places tinged with dark brown, for growth was here much better, the plants including such mat-forming denizens as *Dryas, Saxifraga tricuspidata, Cerastium alpinum,* and larger "creepers" of *Salix arctica.* Indeed very locally, on sheltered but still quite steep mountain slopes near sea-level, there may be found almost anything up to the closed mossy heaths described below as occupying the most favourable, south-facing banks encountered in the district.

(ii) LOWLANDS

These are extremely variable in the conditions they afford for vegetation, although the greater part of the area is taken up by poor and more or less open communities. Thus on the most exposed ridges, or on raised beaches that have only recently emerged from the sea, there may be no more than a depauperate *Saxifraga oppositifolia* "barren" of the type described above from the hilltop. In places the *Saxifraga* may, aided by mosses and lichens, largely cover the area although rarely forming a mat; or the dominance may be taken over by *Salix arctica.* More frequently, however, and covering larger areas, especially where there is some slight shelter and, consequently, snow-covering in winter, *Dryas integrifolia* enriches the community. The degree of control exerted by the *Dryas* is, of course, very variable. Frequently it is considerable, as for example in places near the sea where large tufts of *Dryas* covered about half the area, and where a 2-m. quadrat taken at random gave the following list of higher plants:

Dryas integrifolia	vad
Carex nardina	a
Saxifraga oppositifolia	f
Carex rupestris	o
Kobresia myosuroides (*K. bellardi*)	o
Luzula confusa	o
Polygonum viviparum	o
Salix arctica	o
Festuca brachyphylla	r
Poa abbreviata	r
Saxifraga tricuspidata	r
Stellaria longipes	r
Carex bigelowii	vr
C. rupestris	vr
Pedicularis hirsuta	vr (1)

Mosses were chiefly represented by *Rhacomitrium lanuginosum*, as is frequently the case in places that are relatively exposed and dry, and lichens also were of rather poor growth except in the case of *Cetraria nivalis*, which was plentiful, indicating that there was little if any snow-covering in winter just here. *Alectoria nigricans, Cornicularia divergens*, and *Thamnolia vermicularis* were the other most evident members of the considerable number of associated lichens. In some such areas rough polygons are to be seen, whereas in others the dominance is taken over by *Salix arctica* or, where shelter and snow-covering conditions are more suitable, by *Cassiope tetragona* (*See* under "Snow effect", pp. 53 *et seq.*).

The most favourable situations of all, viz., the occasional south-facing lowland slopes which are well covered with snow in winter and have a lasting supply of water percolating from above but nevertheless remain well drained, are

vegetated by a luxuriant mossy "blueberry heath" dominated by *Vaccinium uliginosum* var. *alpinum* and *Cassiope tetragona.* These dominants may together largely cover the area, the community being in any case fully closed and having a deep, dark, and predominantly humous soil overlying the surface of the distinguished gneissic substratum. Its counterpart on sandstones is much poorer, and, so far as I could determine, no such community is developed on basic soils.

As the following list shows, the associated phanerogams are numerous, and, with the cryptogams, include several that are not known to grow farther north anywhere in our area than they do in these most favourable situations around Dundas Harbour. *Carex scirpoidea* has here its northernmost known station on earth (See Part I, p. 120). Mosses and to a lesser extent lichens form a sward about—or sometimes below—the axes of the dominants; in the example most closely investigated the species were much mixed, and only the more important of these cryptogams are given in the following list taken from a small area:

VASCULARES	*Vaccinium uliginosum* var. *alpinum*	vad
	Cassiope tetragona	a-ld[1]
	Salix reticulata	a
	Kobresia myosuroides (*K. bellardi*)	o-la[2]
	Carex rupestris	f
	Luzula nivalis	f
	Poa arctica	f
	Polygonum viviparum	f
	Salix arctica	f
	Stellaria longipes	r-f
	Carex misandra	o
	Eutrema edwardsii	o
	Dryas integrifolia	o local
	Oxyria digyna	o local
	Cardamine bellidifolia.	r
	Carex scirpoidea	r
	Luzula confusa	r
	Lycopodium selago	r
	Pedicularis hirsuta	r
	Rhododendron lapponicum	r
	Salix herbacea	r
	Saxifraga oppositifolia	r small seedlings
	Tofieldia coccinea	r
	Campanula uniflora	vr
	Draba nivalis	vr
	Pedicularis capitata	vr
	Saxifraga stellaris var. *comosa*	vr
	Pedicularis flammea	(1)
	Potentilla rubricaulis	(1)
	Saxifraga hieracifolia	(1)
BRYOPHYTA[3]	*Aulacomnium palustre*	lsubd
	Sphagnum teres	lsubd
	Abietinella abietina	
	Aulacomnium turgidum	
	Dicranum fuscescens	
	Ditrichum flexicaule	
	Drepanocladus uncinatus	
	Grimmia alpicola	
	Mnium orthorrhynchium	
	Pohlia cruda	
	Polytrichum juniperinum	
	Ptilidium ciliare	
	Rhacomitrium lanuginosum	
	R. sudeticum	

[1] Chiefly in depressions.

[2] Chiefly of raised and eroded hummocks.

[3] Only the more important species are listed.

Lichenes[1]	*Cetraria islandica*
	Cladonia lepidota f. *gracilescens*
	C. uncialis
	Lecanora epibryon
	Ochrolechia upsaliensis
	Peltigera aphthosa
	P. leucophlebia
	Pertusaria pruinifera
	Stereocaulon sp.
Fungi[1]	*Clitocybe metachroa*
	Thelephora terrestris
	Rhytisma salicinum on *Salix arctica*

The dark and very damp, humous soil beneath one big tuft of *Sphagnum* had the lowest pH that I have yet found so far north in Canada, viz., 5·4. Elsewhere there was generally a considerable admixture of mineral matter and, probably, a higher pH. Nor are Sphagna to be found at all frequently in other habitats around Dundas.

The above community, whose chief dominant ripens small but luscious fruits in plenty, probably represents a postclimax under present climatic conditions, the poorer *Cassiope* community in the snow-patch depressions being a

Plate XI

"Tundra polygons" separated by ice-filled cracks and vegetated by a mixed sward of grasses, sedges, and generally some woody plants. Dundas Harbour, Devon Island, Sept. 7, 1936.

physiographically determined subclimax instead of a postclimax as at Craig. The climax proper, or lasting preclimax (as may perhaps be the case also in southern Ellesmere?), is probably the less heathy and more grassy-sedgy community to be seen on flat areas away from the exposed coast (cf. Weaver and Clements 1938, p. 483), although this must remain somewhat doubtful pending

[1] Only the more important species are listed.

further investigation. Up to the present I have had no opportunity of exploring a sufficiently extensive area of this to generalize further than to say that it is probably similar to the community developed on many flat areas farther south, although to what extent it may be dependent upon local fiord-side (as opposed to general) climate is also problematical. Indeed, local effects are likely to be so overwhelmingly (and doubtless lastingly) important that it is to my mind doubtful whether the principles of the climatic climax, which are so useful especially in temperate regions, are really applicable in the Arctic (cf. Trapnell 1933, pp. 298 *et seq.*).

Possibly some approximation to the climax postulated above is represented by a somewhat marshy community to be met with here and there in lowland situations around Dundas, where, however, like the luxuriant heath, it covers only a very small proportion of the area. Unfortunately, the example investigated, unlike most land areas in the North, had been considerably affected by grazing, to judge by the numerous signs of musk-oxen and the caribou antlers scattered around. It was also much disturbed by frost action, the surface being divided by wide cracks or depressions into huge "tundra polygons" (cf. Polunin 1934, p. 354, and Pl. XXX, photo 9) some 15 m. in diameter in the manner shown in Plate XI (*See* also below, pages 254-5, and Plate C, and cf. Leffingwell 1915, p. 653). The following angiosperms, of which the four first named were the most universally important, were generally much in evidence and almost always to be found in this habitat, together with a host of others of more casual occurrence.

Carex aquatilis var. *stans*	vad
Arctagrostis latifolia	a
Eriophorum angustifolium	a
Salix arctica	a
Alopecurus alpinus	
Carex membranacea	
Hierochloe pauciflora	
Luzula confusa	
Poa arctica	
Polygonum viviparum	
Ranunculus sulphureus	
Saxifraga hirculus	
Stellaria longipes	

Mosses and a few lichens had woven the whole into a continuous sward, beneath which was a close though shallow "turf" over the dark, damp, and largely humous soil, which appeared to be of more considerable depth (? perhaps 1-2 m.) than any other encountered in the vicinity.

Besides these more outstanding vegetation types to be met with in the lowlands, and several other more "special" ones that will be described under different headings below, there are various mixed and intermediate (frequently ecotonal) communities that between them cover a considerable area; their occurrence and type being hinted at over and over again, their further enumeration here seems unnecessary.

(iii) GLACIERS AND RECENT MORAINES

The numerous tongues of glacier of varying breadth that persist into the valleys on the south coast of Devon Island and in many cases come right down and calve into the sea have already been mentioned. They dissect the ice-free areas and must considerably limit the local migration of plants, being—probably in common with the ice-cap that occupies so much of the land—generally quite barren. Thus, in September 1934 I could find no trace of "red" snow or ice, or any pools surrounded by gelatinous Cyanophyceae of the type mentioned by

Sutherland (1852, II, p. 206) from Cornwallis Island, on the glaciers or snow patches at Dundas. Nor could I find any sign of life on the "live" drumlins carried on one glacier that I traversed for a considerable distance, although the dark and much-worked gravelly material, of which the surface of these cones consisted, appeared to contain some organic material. Although I have no precise data of the rate of recession of glaciers in the area—if indeed they do recede at all regularly—it appears that colonization of morainic material left by them may proceed rather rapidly, as I have seen to be the case sometimes in Spitsbergen, although in one instance investigated there it seemed to have been difficult and slow at least in the earlier stages (*See* Polunin MS.h).

Thus, from the side of one glacier near Dundas that appeared to have shrunk considerably in recent times, the ground, which consisted of gently undulating morainic material including much finely comminuted soil, was entirely barren for some 10 m. except for one or two plants of *Saxifraga cernua* or *S. caespitosa.* Thereafter, for another belt of similar width, the surface, which appeared eminently suitable for colonization, supported only very occasional isolated individuals of various species. The following were collected within at most 25 m. of the glacier margin, all being of excellent growth; they are probably representative of the more easily distributed and mobile members of the local flora:

Draba alpina
D. fladnizensis
Festuca brachyphylla
Luzula confusa
Oxyria digyna
Papaver radicatum
Poa arctica
Poa cf. *arctica* x *pratensis*
P. glauca
Salix arctica
S. herbacea
Saxifraga caespitosa
S. cernua
S. nivalis
S. oppositifolia
Stellaria longipes

There were a few cyanophycean colonies (*Nostoc* sp.?) on the damp soil, to which they probably added organic matter rather quickly, but otherwise I could not discover any Algae. Although the rocks and stones were devoid of crustaceous lichens a few small tufts of terricolous mosses occurred, and squamules of foliose or fruticose lichens, which unfortunately were not collected; also a large rounded tuft of *Cetraria cucullata,* which appeared to have been blown in from somewhere else.

Farther back *Luzula confusa,* which was more frequent than any other plant near the glacier, became more and more plentiful until, the surface being there bound by cryptogams, the community became completely closed at a distance of about 100 m. from the edge of the glacier (*See* Plate XII, which shows this luxuriant community in the foreground and the glacier behind). A 2-metre quadrat of this older, completely colonized moraine gave the following list; to what extent it may be indicative of a tendency toward the "true climax" I dare not even guess, for here again the area appeared to have been much pastured. Moreover it was in an unusually sheltered situation and did not give the impression

of having yet come to an equilibrium with some important factors of its habitat. But the humus beneath the abundant mosses, which formed a mat into which the feet sank as much as 10 cm. when the surface was unfrozen, was almost as retentive of water as that composing the upper layers of the giant "tundra polygons" described above. In both cases it appeared that the luxuriant growth of the dominant herbs and attendant cryptogams prevented the ecesis of heath plants such as *Cassiope tetragona* and the local *Vaccinium*.

PLATE XII

Closed "meadow", largely covered by freshly fallen snow, extending to within 100 m. of edge of glacier (forming background in centre and on right). The morainic area between is largely barren. Near Dundas Harbour, Devon Island, Sept. 14, 1934.

SPERMATOPHYTA	*Luzula confusa*	vad	
	L. nivalis	f-a	
	Alopecurus alpinus	o-la	up to 35 cm. high
	Poa arctica	f	
	Stellaria longipes	f?	
	Pedicularis hirsuta	o-f	
	Potentilla hyparctica (*P. emarginata* var. *typica*)	o-f	
	Arenaria rubella	o?	
	Salix arctica	o?	
	Cardamine bellidifolia	r?	
	Draba alpina var. *nana*	r?	
	Festuca brachyphylla	r	
	Papaver radicatum	r	
	Saxifraga cernua	r	
	S. nivalis	r	
	S. rivularis	r?	
	S. stellaris var. *comosa*	r?	
	Ranunculus sulphureus	r?	(possibly some *R. nivalis*)

New snow covering the area made listing difficult and necessitated the queries after some of the frequency degrees. It also prevented full computation of the cryptogams, although the following appeared to be the most important:

MUSCI	*Polytrichum strictum*	a	fruiting well
	Aulacomnium turgidum	a	
	Ditrichum flexicaule		
	Drepanocladus uncinatus		
	Pogonatum urnigerum		
	Polytrichum alpinum		
	P. hyperboreum		
	Rhacomitrium canescens		
	Sphagnum teres		
	Timmia megapolitana		
LICHENES	*Stereocaulon alpinum* (incl. with parasite)	a	
	Cetraria delisei	f-a	
	Cladonia lepidota f. *stricta*	f	
	Alectoria ochroleuca		
	Cetraria crispa		
	Cladonia coccifera var. *stemmatina*		
	C. pyxidata var.		
	C. uncialis		
	Peltigera aphthosa		
	Thamnolia vermicularis		

PLATE XIII

Pleuropogon sabinii colonizing areas of inundated mud in marshes dominated elsewhere by *Eriophorum angustifolium*, of which clumps are seen in the middle distance. Note the floating leaves and upright axes of the *Pleuropogon* (cf. Polunin 1932, p. 170). Dundas Harbour, Devon Island, Sept. 7, 1936.

The soil was dark brown and humous to a depth of 25 cm. on the side away from the glacier, but became thinner toward the latter, and in places more mixed with coarse mineral particles. In reaction it was distinctly acid, a pH of 6·0 being measured in the centre of the test area from which the above lists were taken.

PLATE XIV

Eriophorum scheuchzeri forming dense clump on raised beach, which is elsewhere almost barren, and now covered with a sprinkling of new snow. Dundas Harbour, Devon Island, Sept. 14, 1934.

PLATE XV

Luxuriant marsh dominated by Carices, Eriophora, and grasses—bordering a lake but extending well behind. The steep slopes in the distance are of light-coloured dolomite, etc., with some bands of darker and harder rocks. Dundas Harbour, Devon Island. Sept. 7, 1936.

(iv) MARSHES

Marshes of one sort or another cover a large proportion of the flatter areas around Dundas, especially by the sides of the fiord. The dominants vary from place to place, often in accordance with local water conditions. Thus, in those tracts that are inundated most of or all the summer, *Pleuropogon sabinii*[1] colonizes the otherwise frequently bare muddy surface, although often giving way to denser clumps of *Eriophorum angustifolium* in the manner shown in Plate XIII. In more exposed situations, and especially on the more exposed and newly "raised beaches", *Eriophorum scheuchzeri* may form dense and almost pure stands over smaller areas (*See* Plate XIV). The more extensive and altogether typical marshes are, however, those of mixed dominance by Eriophora, Carices, and grasses, which afford the chief summer pasturage of musk-oxen and many wildfowl (especially snow geese), and which are most luxuriantly developed around freshwater lakes and pools (*See* Plate XV). A composite list made from quadrats on two such marshes about 4 miles apart was as follows:

VASCULARES	*Eriophorum angustifolium*	a-vad
	Carex aquatilis var. *stans*	la-vad
	Arctagrostis latifolia[2]	la-vad
	Carex membranacea	la
	Dupontia fisheri	la
	Eriophorum scheuchzeri	la
	Hierochloe pauciflora	la
	Pleuropogon sabinii	absent-la
	Polygonum viviparum	f
	Salix arctica	f
	Saxifraga hirculus	o-f
	Alopecurus alpinus	absent-f
	Saxifraga stellaris var. *comosa*	o
	Stellaria longipes	o
	Juncus biglumis	r-o
	Poa arctica	r-o
	Cardamine pratensis var. *angustifolia*[3]	r
	Draba fladnizensis	r
	Juncus castaneus	r
	Equisetum arvense	absent-r
	Ranunculus hyperboreus	absent-r
	R. sulphureus	absent-r
	Cochlearia (seedlings)	vr
	Eutrema edwardsii	vr
	Lychnis apetala	absent-vr
	Saxifraga cernua	absent-vr

Mosses, the most constantly important of which was *Aulacomnium turgidum*, in most places formed a continuous investment into which the feet sank for 10 to nearly 20 cm. The soil beneath was in most places rather shallow and, although largely of humus, only very slightly acid in reaction. On some drier, slightly raised areas there was to be found a considerable variety of lichens; and almost everywhere about were signs of disturbance by wildfowl. These must considerably increase the available nitrogenous and other food materials and probably contribute appreciably to the luxuriance of the vegetation, which may perhaps be here again fast approaching the "true climax" (whatever this may be, and supposing such to be recognizable!).

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[1] With regard to this decapitalization of 'trivials', *See* Foreword to the present volume; and with regard to the rendering *sabinii*, *See* Polunin MS.g.

[2] Up to 50 cm. in height, which was not exceeded by any plant seen in the district.

[3] Vegetative only, but seen flowering elsewhere at Dundas.

The new snow and frozen conditions made accurate listing of the cryptogams impossible, though the following were collected in marshy terrain around Dundas. Some of them suggest interference by pasturing animals and birds and others indicate disturbance of the area by projecting rocks or dry hummocks, which in some cases approximated to those of "hillock tundra" (*See* pp. 84 *et seq.*). Nevertheless, they seem worth listing, if only to indicate the extreme variability from spot to spot of even these more luxuriant and apparently stabilized areas:

BRYOPHYTA[1] *Aulacomnium acuminatum*
A. palustre
A. turgidum
Brachythecium albicans
Breidleria pratensis
Calliergon giganteum
Campylium polygamum
C. stellatum
Cinclidium subrotundum
Distichium capillaceum
Drepanocladus intermedius
D. revolvens[2]
D. uncinatus
Meesea triquetra[2]
Mnium affine
Orthothecium intricatum
Philonotis fontana
Aneura pinguis
Tomenthypnum nitens

LICHENES[1] *Alectoria ochroleuca* f. *septentrionalis*
Sporastatia testudinea
Caloplaca elegans
Candelariella epixantha
Cetraria cucullata
C. nivalis
Dactylina ramulosa
Lecanora badia
L. dispersa
Lecidea atrobrunnea
L. elata
L. lapicida f. *declinans*
Peltigera aphthosa
P. malacea
Physcia muscigena
Rhizocarpon geographicum
Thamnolia vermicularis
Verrucaria cf. *devergens*

FUNGI[1] *Cortinarius allutus*
Melampsora bigelowii on *Salix arctica*
Paxina hispida

ALGAE Over 50 of the very considerable range of species to be found in peaty pools and depressions in these marshes are listed below (p. 58).

(v) SNOW EFFECT

In places where the snow lies deeply in winter and melts only after summer has come to most areas around, so that the growing-season is appreciably shortened very locally, there is characteristically developed a dark *Cassiope*

[1] Not all marsh species, although found e.g. on hummocks in marshes as explained above.
[2] The record of this species from Dundas Harbour was inadvertently omitted from Part II of the present series.

heath, which is here to be considered as a subclimax (*See* p. 46) although in other ways it is remarkably like the postclimax developed at Craig Harbour (*See* p. 27). Indeed, the similarity is so close that it would be superfluous to list the plants here; all the chief phanerogamic species are the same, but the dominant tends to be more nearly closed than at Craig and the flora is rather larger. Thus, in one example listed it included *Salix reticulata* and *S. herbacea*, which are unknown to the north, and *Vaccinium uliginosum* var. *alpinum*, which has not yet been found anywhere around Craig. The cryptogams are also closely comparable in the two places, but tend to be better grown and less mixed at Dundas, where, also, there were notable additions in *Dicranum brevifolium*, *D. scoparium*, and *Cetraria cucullata*.

PLATE XVI

"Late-snow" area (partly covered by new snow) in mid-September, showing *Oxyria digyna* (upper half of centre), *Papaver radicatum* (in centre by pipe mouthpiece), *Cerastium alpinum* (right foreground), and *Potentilla* sp. (top left-hand corner), all flowering still. Dundas Harbour, Devon Island, Sept. 14, 1934.

As on Akpatok Island (*See* Polunin 1934, pp. 386-7), this *Cassiope* subclimax usually forms a zone surrounding the more truly "late-snow" areas, over which the snow drifts deeply and melts so late in summer that their growing-season is greatly reduced in length. Here such plants as have attained ecesis are often to be seen still flowering in September when all around have long been "over", and when "killing" frosts and snows cut back these late specimens and prevent them from ripening fruit (*See* Plate XVI). Thus at Dundas on Sept-

ember 14, 1934, I noticed the following still in flower, all in more or less "late-snow" areas—though how many would recover from the frosts of the previous night, should warm days come again, I could not say:

Arenaria rossii
Cerastium alpinum
Draba fladnizensis
D. nivalis
Oxyria digyna
Papaver radicatum
Potentilla hyparctica (*P. emarginata* var. *typica*)
P. rubricaulis?
Ranunculus nivalis
R. sulphureus
Saxifraga caespitosa
S. cernua

Although the exclusively "late-snow" species of the south are in most cases absent from these northern regions, there is, toward the centre of the latest melting snow patches, a greater tendency toward restriction of the species to plants that can vegetate quickly in the very short growing-season there. The community tends to become more and more sparse and open, and altogether quite reminiscent of such areas as those listed on pages 29-30 from Craig, although the plant colonists tend to be more varied and their growth better at Dundas, probably owing to the warmer summer in the south (cf. p. 35). Thus, from a 4-metre quadrat in one such area at Dundas, I made the following list[1]:

Oxyria digyna	a
Luzula confusa	f
L. nivalis	o-f
Saxifraga cernua	o-f
Salix herbacea	r-f?
Ranunculus nivalis	o
Salix arctica	o?
Stellaria longipes	o?
Cerastium alpinum	r
Braya purpurascens	r?
Draba fladnizensis s.l.	r?
Potentilla hyparctica f. *tardinix*[2]	vr
Saxifraga caespitosa	vr
S. oppositifolia	(1 seedling)

The queries to some of the frequency degrees given above are necessitated by the fact that a sprinkling of new snow impeded observation; it also prevented investigation of the cryptogams,[3] which in any case were of poor growth. Nevertheless, the pH appeared to be rather low (possibly below 6·0, and certainly lower than in the surrounding *Cassiope* zone). In some places beside perennial or everlasting patches of snow or *névé* the innermost zones were even more poorly vegetated, sometimes being almost devoid of vascular plants, or, in spots that were left bare only in exceptionally warm summers or series of summers, being restricted to a few algal colonies and young bryophytes here and there on the wet and generally muddy surface. Even rocks in such situations are generally quite devoid of crustaceous lichens, but they may support a thin investment of Cyanophyceae on their under surfaces.

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[1] *Arenaria rossii*, *Braya purpurascens* var. *dubia*, and *Cerastium regelii*, although not occurring in the example listed, are characteristic of, and possibly confined to, such late-snow areas around Dundas.

[2] *Potentilla hyparctica* Malte f. **tardinix** (Polunin) *n. comb.* (*P. emarginata* Pursh f. *tardinix* Polunin, Bot. Can. E. Arctic I, p. 275, 1940; *See* also Fernald in Rhodora, XLV, p. 111, 1943).

[3] It was, however, evident that the more important species included *Distichium capillaceum*, *Ditrichum flexicaule*, *Drepanocladus uncinatus*, and *Timmia austriaca* among the mosses and *Cetraria crispa*, *C. delisei*, and *Stereocaulon alpinum* among the lichens.

(vi) SPECIAL LOCALIZED HABITATS AND COMMUNITIES

Many types of area and accompanying vegetation that could quite legitimately be considered here seem best treated elsewhere. The present category accordingly becomes a "rubbish heap" (such as one finds in almost all classifications, of no matter what, in the biological sciences) of types that do not fit so well into the general scheme of things, although they cannot be ignored. Around Dundas only two of these were encountered, viz., "raised beaches" and old Eskimo encampments. Apparently undisturbed examples of the former are in places fairly frequent low down near the sea, and their surfaces of closely packed, marine-assorted material are generally occupied by "barrens" of one sort or another (*See* p. 44) or, in "older" and more sheltered situations, by heathy or grassy communities. The following angiosperms were the ten most frequently noted as ecologically important on the younger raised beaches, i.e., those not more than 15 m. above the level reached by the highest tides[1]:

Carex misandra
C. nardina
Dryas integrifolia
Festuca brachyphylla
Luzula confusa
Papaver radicatum
Poa arctica
Salix arctica[2]
Saxifraga oppositifolia
S. tricuspidata

It may be remarked that seven of these are among the twelve species noted as more than very rare on the richer *Dryas* areas occurring above (cf. p. 44) and that, although the terrain is here very dry, six are among the sixteen first colonists of open (generally damp) moraines (cf. p. 48).

The old Eskimo encampments cover, of course, a very small area. Although they have been deserted for probably at least 100 years (according to Mr. Douglas Leechman of the Division of Anthropology, National Museum of Canada), they are still notable for the relative luxuriance of the vegetation that even now covers their area. This vegetation is predominantly grassy, consisting in one notable instance of an almost pure stand of *Alopecurus alpinus,* and in another of *Poa arctica* (including an apparent hybrid with *P. pratensis* that, however, does not, so far as is known, occur in the pure state on Devon Island) with associated *Luzula confusa, Puccinellia angustata, Hierochloe alpina,* and *Chrysosplenium alternifolium* var. *tetrandrum.* The sward, although closed, is thin, and already in places shows signs of succumbing to aggression by *Salix arctica* creepers; that it has held its own thus far may perhaps be due more to retention of phosphates than of nitrates by the coarse, easily leached sand covering these prominences.

(vii) FRESHWATER

As at Craig Harbour, most of the streams at Dundas have been more or less dried up or frozen in autumn when I have visited the area. The one shown in Plate XVII was, however, still running in mid-September 1934, although most of the bouldery bed was dried up and barren except for occasional Algae or

[1] The blue-green Algae *Gloeocapsa fuscolutea, Nostoc paludosum,* and *Tolypothrix bouteillei* were collected in a damp depression on one raised beach, but to what purpose I neither made any note nor have any recollection. It may be that they precede *Eriophorum scheuchzeri,* which occasionally in damp places near the sea forms patches of marsh like that illustrated in Plate XIV.

[2] Frequently parasitized by *Melampsora bigelowii.*

mosses of the types (but not necessarily the species) mentioned on pages 31-2 from Craig Harbour, where similar conditions apply. The "open soil" plants *Saxifraga oppositifolia* (cf. Polunin 1939c, pp. 131-2) and *Luzula confusa* were the first phanerogamic colonists on the banks.

PLATE XVII

Stream still running in autumn. The bed is largely dried up and barren, as is seen on the right. In the distance in centre an iceberg is visible at sea. Dundas Harbour, Devon Island, Sept. 14, 1934.

In the stream itself were collected, chiefly in slower eddies, the following Algae (belonging to various groups but excluding diatoms):

Aphanocapsa grevillea
Cosmarium holmiense var. *integrum*
C. laeve
C. undulatum
Microcystis pulverea
Rivularia biasolettiana
Tolypothrix tenuis
Zygnema sp. (sterile)

The only phanerogam to be seen in such situations at Dundas was *Ranunculus hyperboreus,* which sometimes rooted in the bed and had leaves coming up and floating on the surface where the water was not too deep, as in Spitsbergen (cf. Polunin MS.h).

Lastingly inundated areas occurring in marshy places have already been described (p. 52) and illustrated in Plate XIII. The most characteristic phanerogam here is *Pleuropogon sabinii,* although Eriophora dominate more stable clumps in some places, and *Ranunculus hyperboreus* may form a close tangle in sheltered microbays. In very shallow water, or sometimes out of it, the surface hereabouts is frequently darkened by *Nostoc* and other cyanophy-

cean colonies that appear to result in quite rapid humous accumulation, and in more lastingly peaty or mossy pools there is to be found a very considerable range of Algae, which included the following at the end of the first week of September in 1936:

Achnanthes flexella
A. minutissima var. *cryptocephala*
Amphora ovalis var. *affinis*
Aphanocapsa grevillea
A. muscicola
Caloneis silicula var. *alpina*, var. *genuina*, and var. *subundulata*
Closterium ehrenbergii var. *malinvernianum*
C. jenneri
Cosmarium abbreviatum var. *planctonicum*
**C. botrytis*
C. curtum
**C. holmiense*
C. plicatum var. *hibernicum*
**C. porkonyanum*
C. ralfsii
C. speciosum
Cymbella angustata var. *hybrida*
C. botellus
C. cuspidata
C. heteropleura var. *minor*
C. tumidula
C. turgida
Denticula tenuis var. *intermedia*
Diatomella balfouriana
Euastrum ausatum
**E. bidentatum*
Eunotia praerupta var. *genuina*
Gloeocapsa montana
**Merismopedia glauca*
Microcystis flos-aquae
Navicula cincta var. *heufleri*
N. pupula
N. tuscula
N. vulpina
Nitzschia angustata
N. frustulum
N. sinuata
N. subtilis var. *paleacea*
Nostoc commune
**N. sphaeroides*
Pinnularia spitsbergensis
P. viridis var. *intermedia*
**Pleurotaenium truncatum*
Rivularia compacta
Scytonema crustaceum[1]
**Staurastrum bieneanum*
Stauroneis anceps var. *amphicephala*
S. phoenicenteron var. *amphilepta*
Synedra ulna var. *genuina*
Tabellaria fenestrata
**Tolypothrix tenuis*
Xanthidium antilopaeum var. *triquetrum*

In larger pools and lakes Algae are frequently less in evidence than aquatic mosses, the hydrosere being variable but most commonly of the type indicated by the zonation described below from northern Baffin. The marginal com-

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*Sometimes occurring in considerable abundance.

[1]Embedded in irregularly shaped calcareous nodules that were inside the hollow tubes of an extensive *Nostoc* colony.

munities tend to be much disturbed by snow geese and other wildfowl, some of which seem especially partial to the usually dominant *Carex aquatilis* var. *stans,* whose leaves they crop and whose axes they frequently pull up from deep down in the mossy sward that develops in these manured areas.

(viii) STRAND AND MARINE

The seashore is much better vegetated than at Craig. Although *Elymus arenarius* and *Arenaria peploides* are absent, so far as is known, characteristic flat rosettes of *Mertensia maritima* var. *tenella* may be found colonizing the otherwise barren shingle just above high watermark. In sandy or muddy places *Carex ursina* and phases of *C. salina* and *C. bipartita* are to be found, with the usual *Puccinellia phryganodes* and *Stellaria humifusa,* whereas in sheltered places and especially alongside lagoons a more extensive saltmarsh community is developed. A composite list taken from two such areas is as follows:

Puccinellia phryganodes	vad
Stellaria humifusa	o-a
Carex ursina	r-a
C. salina apprg. var. *subspathacea*	la
C. bipartita var. *amphigena*	absent-o
Sagina intermedia	absent-o
Saxifraga cernua	r
Carex maritima var. *setina*	absent-r
Phippsia (Catabrosa) algida	absent-r
Potentilla pulchella	absent-r
Puccinellia paupercula	absent-r
Ranunculus hyperboreus	absent-r
Saxifraga caespitosa	vr

A sample of the reddish brown surface investment of damp mud, taken at the margin of a brackish lagoon on September 7, 1936, was found to contain the following nineteen Diatomeae:

Achnanthes minutissima var. *cryptocephala*
Amphora dubiosa
Cocconeis placentula
C. scutellum
Cymbella botellus
C. cistula var. *maculata*
Fragilaria pinnata
Melosira granulata
Navicula cincta var. *heufleri*
N. radiosa var. *genuina*
N. rhyncocephala var. *brevis*
N. salinarum
N. variabilis var. *capitata*
Nitzschia amphibia
N. commutata
N. frustulum
Pinnularia brebissonii var. *genuina*
Synedra minuscula
S. pulchella

The lower shore tracts are often largely closed by a mat of Algae, especially *Enteromorpha micrococca* and *Pylaiella*[1] *littoralis,*[2] but above the levels reached by ordinary high tides these disappear almost immediately, the dominant *Puccinellia* itself losing its hold and soon giving way to one of the usual communities of recent shingle or other seaside areas, which higher up join the more stable vegetation of the coastal plains.

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[1] Named after Bachelot de la Pylaie, the common rendering 'Pilayella' and the less common 'Pilaiella', being typographic or unintentional orthographic errors, should be corrected (*See* 'International Rules of Botanical Nomenclature', ed. 3, Art. 70, 1935).

[2] Based on *Conferva littoralis* L., Sp. Pl., ed. 1, p. 1165, 1753, the rendering 'litoralis' being accordingly incorrect.

Between tide-marks in more exposed or rocky places there are to be found Fuci of rather limited growth (cf. p. 33), with such other Algae as *Enteromorpha minima, E. prolifera* var. *trabeculata* (especially around high water-mark), *Pylaiella littoralis, Rhodochorton rothii,* and *Ulothrix implexa.*

Below low tide-mark, growth is much more luxuriant, the plants including large laminarian and other denizens growing in dense beds. The following species were to be found cast up on the shore in considerable abundance in a fresh condition:

Agarum turneri
Ahnfeltia plicata
Alaria esculenta
Desmarestia aculeata

Sea life of animals such as Crustacea and Mammalia (especially white whales and seals) is also at times remarkably abundant around Dundas.

(3) NORTHERN BAFFIN

Baffin Island is approximately 1,000 miles (1,600 km.) long and has an estimated area of 201,600 square miles (Bethune 1935, p. 16), being the largest "island" in the Arctic apart from Greenland. It lies entirely within our Eastern Arctic area, whose main land-centre it constitutes, at least in the south. About one-third of the area of Baffin may be cut off as the northern section by a line drawn in an exact southwesterly direction from a little north of Cape Adair on the east coast to the shore of Foxe Basin on the west. This district may most conveniently be made to include Bylot Island, which indeed on two sides is only separated by narrow straits[1] from the mainland of Baffin, and has itself an area of some 5,000 square miles. The district so constituted extends from about 73°50′N. southwards to 69°30′N., and from about 72°W. to 90°W.; in spite of numerous coastal indentations, it forms a rather good and compact whole for phytogeographical or ecological consideration.

Geographically speaking this area is now fairly well known, thanks in large measure to the energetic work of the Fifth Thule Expedition, 1921-4. As a result principally of his own and Freuchen's investigations during this expedition, Mathiassen has published (cf. 1933) a rather detailed account of the very variable topographical features of most of the land, with data on local physiography in many places. To this I recommend the reader—especially to Mathiassen's "Topographical Description" (1933, pp. 24-68). However, for those students to whom this work is not easily available a few brief notes may be given, gleaned from this and various other sources, including personal observation.

Except around Brodeur Peninsula in the west, the coastline is in most places very irregular, being dissected by bays and fiords of which one, Admiralty Inlet, is over 300 km. in length and probably the longest fiord in the world. There are rather many inland lakes and coastal islands known to white men, and certainly many more of both to be discovered.[2] The physiography is in most places rugged, although considerable tracts of low and more or less flat country occur. As with the lands farther north, altitudes tend to decrease and the flatness of the land on the whole to increase to the westward. Especially are the highest peaks, by far, confined to the east, where at least one on Bylot Island attains

[1]These are frozen over continuously during the winter and spring months.

[2] Already since this was written not a few such features have come to light through the activities of Messrs. T. H. Manning, P. D. Baird, and others. The Spicer Islands, which we located near the middle of Foxe Basin during our airborne expedition in the summer of 1946, and the large new island to their north, would seem best included in the next major district dealt with below, viz., central Baffin. *See* also Polunin MS.o.

an altitude of around 2,000 m., and where the Baffin Bay coast appears more rugged and majestic than any part of Labrador, Norway, or even Spitsbergen—indeed than any coast I have seen, except in Greenland. The shores of this little-known east coast are in many places of sheer and lofty cliffs, with high mountains behind, and there are long fiords, snowfields, and many glaciers. Inland is a small ice-cap, and there is said to be a much more extensive one, belonging chiefly to central Baffin, abutting on the southeastern boundary of this present sector. Most of the interior of Bylot Island is also covered by a large ice-cap, from which glaciers descend to dissect the ice-free coastal areas at rather frequent intervals. Elsewhere, especially in the western parts of the land, are other, much smaller and thinner ice-caps, which appear to have the nature rather of local snowfields. The southeastern corner of this major district of northern Baffin has recently been explored by Mr. J. M. Wordie, who gives (1938, pp. 403-8) an interesting account of its varying physiographic and geomorphological features, and of the long and narrow fiords that here penetrate far inland in a southwestern direction.

GEOLOGY

For an account of the geology I would again refer my readers to the above-mentioned report of Mathiassen, and to his map (1933, Plate 3) published in the same work that summarizes all the geological data hitherto accumulated from northern Baffin. The main features are that the easternmost parts, probably including most of Bylot Island, are of Archæan age (principally granites and gneisses); so also are the southwestern areas. Most of the north and west coasts are occupied by Lower Palæozoic sediments (principally limestones and sandstones of the types seen farther north and west), which also form the adjacent hinterland wherever this has been explored, and further outcrop in the central plains and on the south coast. In several places there are coal-bearing, presumably Tertiary, deposits exposed over areas of smaller extent; those so far known are principally in the northeast around Bylot Island or on the south shore of Eclipse Sound.

CLIMATE

Although precise data are lacking from most areas, the climate of northern Baffin may be expected to tend, on the whole, to be more favourable than that of Devon, etc., Islands, which lie to the north and west. However, a comparison of the following temperature table from Pond Inlet in the former district with that given on page 35 for Dundas Harbour on the south coast of Devon Island, indicates that this is not everywhere the case; indeed Pond Inlet tends to have a colder winter than Dundas, and a summer that is little if at all warmer,[1] with the thermometer likely to fall below freezing point on any day even in the height of summer, and with new ice sometimes forming on the sea before the end of August. Again, although precipitation data have been taken only very irregularly at Pond Inlet, it appears that the total rainfall and snowfall is no higher than at Dundas, and may well be lower, although here again it is largely concentrated into the summer months. Thus, during the 10 months that such data were taken at Pond Inlet in 1934, the total precipitation was only 4·44 inches (112 mm.). Altogether, it appears that Pond Inlet does not benefit climatically to any marked degree from its "fiordside" position well away from the open

[1] Bernier (1910, p. 44) even reports that the vegetation of Melville Island, much farther west, "springs up earlier than around Albert Harbour" in Pond Inlet.

sea—or, as much as some other areas, from the "southeasterly circulation up Davis Strait" (*See* Middleton 1935, p. 28). To what circumstance or combination of circumstances the relative luxuriance of its vegetation is due, is not yet at all clear.

Temperatures at Pond Inlet, 72° 43′ N., 77° 45′ W. Average 1931-4

Month	Maximum °F.	Minimum °F.	Monthly mean °F.
January	− 2	−52·5	−29
February	2	−54	−31·5
March	7	−48·5	−22
April	22	−32	− 7
May	39	−11	19
June	54	20	34
July	61	30	42
[1]August	59	30	41
September	45	16	32
October	33·5	− 3·5	17
November	25	−29	− 6
December	5·5	−42	−21

[1]Average of 3 years only.

It may be noted that Port Bowen, in spite of its exposed position on the west coast, appears, so far as can be gathered from the rather deficient details brought back by Parry's third expedition (*See* Parry 1826, app. pp. 11 *et seq.*), to have a climate rather similar to that of Pond Inlet.

VEGETATION

Unlike the flora, the vegetation of northern Baffin remained virtually uninvestigated until my excursions into the region in 1934 and 1936. For our information we shall, accordingly, have to rely almost entirely on the resulting field observations, which, fortunately, were made in some detail and at two widely separate (and geologically and physiographically different) stations. Indeed I venture to think that, in the presence of these studies, it will be permissible to pass over most of the cursory references to the vegetation of the district by technically unqualified visitors although there are, of course, some that are worthy of mention. Nevertheless, I feel it is a great pity that my friend Peter Freuchen and his energetic compatriot Therkel Mathiassen were not able to take more note of the vegetation during their extensive travels in the hitherto little-known southern parts of this district in 1922-24. Had they done so there and on Melville Peninsula, there would have remained no major part of our area from which details of the vegetation are virtually lacking.

The first notes about the vegetation of this district come from John Ross (1819, p. 179) who, if not always a very reliable observer, yet says quite definitely about the region of Cape Byam Martin in the extreme northeast, which otherwise is still practically unknown, that "The valleys......were found to be covered with verdure and wild flowers, the mountains on each side were immensely high, and covered with snow. On the S.E. side of the valley there was a small plain, which was also covered with verdure, and the scenery, altogether, was much more pleasing than any that had been seen during the voyage." With this we may compare King's similarly enthusiastic account (1852, 127) of nearby Possession Bay, whence Parry (1821, p. 26) had already reported "Considerable tufts of moss and of grass. . .".

Again, of Button Point (latitude 72° 50′ N., longitude 76° 30′ W.), in southeastern Bylot Island, Sutherland writes (1852, II, pp. 323-4) that it "looked as green as any English meadow, and the grass upon it was not one whit less luxuriant. The foxtail grass (*Alopecurus alpinus*) and the chickweed (*Cerastium alpinum*), and hosts of other grasses and herbaceous plants, grow among the bones of animals, and are stimulated, by the oil and animal matter which they contain, and by the filth which is inseparable to Esquimaux habitations, to a degree of luxuriance which no one would be willing to assign to the 73rd parallel of north latitude". It is true that in this instance the luxuriance is, in the main, directly due to biotic disturbance; but is it not possible that these extreme northeast coastal points are favourably affected by the warm southerly currents and drifts that make the west coast of Greenland, on the other side of Baffin Bay and Davis Strait, so notoriously luxuriant to a still higher latitude? Even the country to the west of Button Point, although appearing rockbound and inhospitable from the water, seems to be favoured to some extent, for of it McClintock writes (1859, p. 152) "The lands enjoying a southern aspect, even to the summits of hills 700 or 800 feet in height, were tinged with green; but these hills were protected by a still loftier range to the north. Upon many well-sheltered slopes we found much rich grass. All the little plants were in full flower; some of them familiar to us at home, such as the buttercup, sorrel, and dandelion".

On the other hand, not so much farther west, of "one of the Wollaston Islands on the west side of Navy Board Inlet", Goodsir (1850, pp. 110-1) reports "I then hurriedly walked round the island, and found scattered about on it many large worn boulders of granite, some of them more than half way up to the highest point, which I should say was about fifty or sixty feet above the level of the sea. There was scarcely any vegetation to be seen; two species of grasses, and a saxifrage (*Saxifraga oppositifolia*) were all that I could gather".[1] Indeed the vegetation appears on the whole to get poorer and poorer to the westward, at least on the limestones and sandstones that occupy most of the northern part, although even here there can be fairly luxuriant communities quite locally, as for example in places around Arctic Bay (*See* below), and possibly in the extreme northwest at Cape York, which Markham (1875, p. 153) says is "apparently covered with some description of vegetation, it having a brownish-green sort of colour, which was pleasing to the eye."

An early but reliable observer of the western districts was Parry, to whose expeditions we still owe all our information regarding the vegetation of some considerable tracts of land. Thus, in the neighbourhood of Port Bowen (latitude 73° 15′ N., longitude 89° W.) on the northwest coast, Parry's wintering place in 1824-5, it is evident that vegetation is extremely scanty (cf. Parry 1821, p. 44). Hooker, in his botanical appendix to Parry's account of his 'third' voyage (cf. 1826), speaks of "the extreme poverty of the soil", and J. C. Ross in the zoological appendix of "the extreme sterility of the country". However, Parry (1826, p. 151) reports the presence of some vegetation "wherever the soil allowed any to spring up", and also notes (p. 81) that *Dryas integrifolia, Saxifraga oppositifolia, Salix arctica*, and *Draba alpina* are plentiful enough to support ptarmigan, although to be sure this is the case almost everywhere in the Arctic. The country inland, to the east of Port Bowen, sounds even more barren and

[1] I will not attempt any explanation of Bernier's remarkable observation at a point on the west coast of Bylot Island, a few miles south of Canada Point. Bernier writes (1912, p. 77) "A trip was made up on the north side of a river, and the men arrived at an elevation of 1,750 feet. Here there were some striking evidences of former vegetation. There was deep soil and part of an old tree, lying horizontally, was found embedded in the soil. The wood was in a good state of preservation, enabling the men to cut away portions......"

dreary than the coast (*See* Parry 1826, p. 82, and cf. engravings at back), although at its best this last had earlier (by Parry 1821, p. 38, at a landing place in lat. 72° 45′ N.) been described as affording "scarcely any appearance of vegetation, except here and there a small tuft of stunted grass, and one or two species of saxifrage and poppy."

By way of contrast the south coast of northern Baffin, especially where it abuts on Fury and Hecla Strait and is composed of Archæan rocks, appears to be relatively well vegetated. So, also, are some of the adjacent islands. Thus, of Whyte Inlet off the north shore of Fury and Hecla Strait, one of Parry's officers, after a year spent in Melville Peninsula and elsewhere to the south, reports that "At the head of the inlet we found two ravines running into it, and the vegetation was here more abundant than any I had seen during the voyage. . . ."; but although this vegetation "was remarkably abundant, yet the plants were singularly backward and dwarfish, and flowers rare" (Parry 1824, pp. 349-350). Later during the same 'second' expedition Lieut. Hoppner, another of Parry's officers, reported of the region of Gifford Fiord, farther east, that "The land on each side was high, and where we stood was more closely covered with vegetation than any spot I had ever seen in these regions. The dwarf willow grew to a height and size almost entitling it to be called a shrub, and the *Andromeda tetragona*[1] was in the greatest abundance" (Parry 1824, p. 466). Hoppner had previously recorded that, when they had pitched their tent "in the midst of an Esquimaux encampment", the women brought them roots of *Potentilla pulchella,* "which they had pulled whilst collecting dwarf-willow for their fires, and which had a pleasant flavour, resembling liquorice, but not so sweet" (Parry 1824, p. 453).

Concerning the Calthorpe Islands in the north of Foxe Basin, Parry remarks (1824, p. 285) of the middle island that "we found the south end covered with winter huts. . . . , but so overgrown with long rich grass as to indicate their having been two or three years deserted", and of the outermost one "which from the quantity of sea-weed floating near it, we distinguished by the name of Tangle Island", that it had "much shoal water about it". On the nearby Tern Island (latitude 69° 33′ N., longitude 80° 51′ W.) Parry notes (1824, p. 284) that "There is a good deal of vegetation. . ." and Lyon (1824, p. 255) speaks of gathering "some pounds of this stringy and withering vegetable. . ." (*Cochlearia*).

Of the east coast of northern Baffin even less is known, in spite of its relative accessibility. The region south of Cape Coutts is one of especially drastic topography and physiography, with tall mountains, many glaciers, and long fiords. It was visited in 1937 by Mr. J. M. Wordie, who tells me that the vegetation inland, around the heads of the fiords where the land is often lower, the main ridge here lying to the east, is in many places quite luxuriant (cf. Wordie 1938, photo facing p. 407), although the sides of the fiords are more frequently of sheer rock walls or screes that appeared to be quite barren (*ibid.*, photo facing p. 405). The vegetation may also be quite luxuriant in sheltered side-bays nearer the coast (*ibid.*, photo facing p. 399), where most of the highest land lies, and where there may occur "very likely grazing ground" for caribou (*ibid.*, p. 405). Members of Wordie's expedition were especially impressed by the autumn tints in early September (cf. Wordie 1938, p. 407), and by the abundance on some of the beaches on which landings were made of a blue-flowered leguminous plant (probably *Astragalus alpinus*). The vegetation of the plains that lie to the southwest of this region is said by Low (1906, p. 123), following Eskimo reports, to be continuous in most places and to afford pasturage for large numbers of caribou.

[1] *Cassiope tetragona.* (N.P.)

Plant Communities Around Arctic Bay

Arctic Bay is a sheltered cove lying in latitude 73°5′ N., longitude 84° W., off Adams Sound, Admiralty Inlet, northwest Baffin. The country farther north, around the mouth of Admiralty Inlet, is a rather high and monotonous plateau, bounded by steep cliffs or scree slopes that are dissected at frequent intervals by narrow valleys. Southward the land tends to become lower. This transition has already commenced at Arctic Bay, whose district is one of variable physiography, even if the changes tend to be less frequent and drastic than at Craig and Dundas, owing to the local absence of glaciers and paucity of high mountains. Around the coast there are in most places fairly broad outwash plains, backed by tall screes coming from fast-weathering crags. The hinterland is undulating and, as far as it could be explored or seen, rarely rises above 1,200 feet (366 m.).

The local geology is intricate, comprising primarily a great series of sedimentary rocks cut by numerous diabase dykes. The sedimentary series consists of limestones, very dark shales, and a great thickness of variously coloured sandstones and quartzites, some of which are highly ferruginous. The soil in many places effervesces animatedly with HCl in the cold. Near the dykes, the limestones of the sedimentary series have been metamorphosed to pure white, compact, crystalline limestone (marble), and the sandstones to quartzite. The lowlands again are largely of marine terraces and undulating beach ridges, some of which consist of unbound shingle that looks quite fresh. In origin and chemical nature their surface materials are much mixed and variable, often including pebbles of chocolate-coloured argillite. In the shale areas a coating of melanterite frequently appears on exposed surfaces or crumbs of soil, deposited as an efflorescence from waters that have penetrated the shales.

In the face of these almost endless local variations in substratum it is fortunate for the ecologist that, in contrast with the situation at Craig and to a lesser extent at Dundas, plant growth is sufficiently luxuriant at Arctic Bay to enable the vegetation really to take hold over many areas, with the result that the colonists do not change quite so drastically from place to place. I was also fortunate on one occasion, during the Canadian Eastern Arctic Expedition of 1936, in being able to spend no less than 4 full and consecutive working days ashore at Arctic Bay, whose vegetation over a considerable area could, accordingly, be surveyed in some detail. Although this was in the second week of September, the season was here less advanced than farther north, where winter was already at hand.

Below I will give an account of the more areally important or ecologically significant plant communities noted, leaving undescribed (though not always unmentioned) the mixed or intermediate ones that also between them cover much of the area. When to these descriptions are added the accounts given below of some other communities from another and quite distant and different part of northern Baffin, we shall have, I believe, a reasonable survey of the chief vegetation types of much of this major district. It must be remembered, however, that Bylot Island has been little investigated, although the indications are that its vegetation is most closely comparable with that of the similarly heavily glaciated adjacent part of Devon Island, e.g., around Dundas Harbour (*See* above).

At Arctic Bay the local habitat factors are far less overwhelmingly dominant, the vegetation being enabled generally to exert a more definite control, than was the case at Craig or even Dundas. A result is that a smaller number of communities (as well as less variable colonists—*See* above) are concerned with the occupation of most of the area, and rather fewer need be described here.

(i) MOUNTAIN SUMMITS AND UPLANDS

The summit of the highest mountain climbed, which with one possible exception appeared to be the highest for many miles around, was 1,800[1] feet (549 m.) above sea-level and overlooked Arctic Bay. The surface was flat and its component material, which consisted for the most part of angular chunks of yellowish grey rock that effervesced with HCl in the cold when scratched, was sorted into very rough "stone polygons" (cf. p. 20). There were some intermixed erratics of dark acidic rock, and a little fine sand and earth formed by the frost-shattering and general erosion of the limestone-like predominant.

The vegetation was very scanty, being most reminiscent of that of the rather similar plateau areas at Craig, although considerably less depauperated. Thus the chief plant species, as usual *Saxifraga oppositifolia*, frequently showed six or eight individuals to the square metre, and sometimes their growth was sufficient to enable them to cover very locally as much as one-quarter of the area. In those places where the polygons were most dynamic the vegetation was much poorer, and largely limited to the periphery of the polygons or to the tracts intervening between them.

A 4-metre quadrat from this mountain top yielded the following list:

SPERMATOPHYTA	*Saxifraga oppositifolia* f. *pulvinata*	f-la
	Cerastium alpinum	o
	Draba alpina var. *nana*	r-o
	Arenaria rubella	r
	Papaver radicatum	r

Cryptogams were of very poor growth, the rock surfaces being largely bare even of crustaceous lichens. Nevertheless, a fair number of species occurred, of which the following appeared to be the most important:

MUSCI	*Distichium capillaceum*	
	Ditrichum flexicaule	
	Myurella apiculata	
	Tortella fragilis	
	Tortula ruralis	
LICHENES	*Alectoria ochroleuca*	f
	Lecidea elata	
	L. lapicida f. *ecrustacea*	
	Rhizocarpon geographicum	

Much of the less lofty but still semi-desert upland country of the district is vegetated by these *Saxifraga oppositifolia* barrens, although it is only on the most exposed ridges of all that the vegetation is quite as depauperate as on the mountain summit listed. Generally there is some associated *Dryas* or *Salix arctica*, together with occasional herbs and a host of cryptogams; indeed these mixed communities occupy such considerable areas, both inland at higher altitudes and near the sea in similarly dry and exposed situations, that most of the land from a distance looks yellowish grey and barren—due to the colour of the exposed rock or of the material formed when it weathers.

With slightly better conditions, such as obtain on the upper levels of the sides of the rounded hills and ridges, or over the gentle undulations that occupy much of the hinterland, rather better *Dryas integrifolia* "barrens" tend to be developed. The vegetation is still open and generally sparse, appearing light coloured from afar, the surface being generally of much-weathered sandstone or limestone *fjellmark*,[2] or of glacier-worked material including many rounded

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[1]This was the figure given by my aneroid, although this "King George V Mountain" is generally said to be 1,850 or 1,860 feet high.

[2] Current Norwegian for arctic or alpine stony desert—literally 'mountain ground'.

boulders. The degree of covering varies, but "higher" vegetation most typically occupies only about one-tenth of the area, and consists for the most part of tufts of *Dryas* from 5 to 15 cm. in diameter and rising scarcely at all above the surface. One such area, at an altitude of about 800 feet (244 m.) on the peninsula between Arctic Bay and the mouth of Strathcona Sound, gave the following list of vascular plants from a 4-metre quadrat:

Dryas integrifolia	f-ad
Saxifraga oppositifolia (incl. f. *pulvinata*)	f
Carex nardina	o
Salix arctica	o
Carex rupestris	r
Cerastium alpinum	r
Papaver radicatum	r
Polygonum viviparum	r
Carex misandra	vr
Braya purpurascens	(1)
Draba alpina var. *nana*	(1)

Thus only four species of angiosperms occurred more than a few times in an area of 16 square metres and could be given a frequency degree of more than "rare." The "soil" was light coloured and almost devoid of humus—except occasionally under some of the larger *Dryas* tussocks. It was highly calcareous and effervesced furiously with HCl. Although cryptogams are frequently much more numerous, especially in the less exposed of these areas where the vegetation may be locally almost closed, they were, in the example listed, extremely few and poorly grown. That the area was not always desiccated was indicated by the presence of cyanophycean investments on the under sides of some of the loose stones, and of the liverwort *Lophozia alpestris* on some open patches of mineral earth. Nevertheless, drainage is very good and exposure rather severe, the degree of aridity being evidently at times considerable (cf. Akpatok Island, below), as is further evidenced by the limitation of mosses to occasional scraps —most often of *Tortella fragilis*—"wedged" between the larger stones. Other inimical factors here are evidently the basicity and instability of surface of the predominant limestone, for in contrast with the nearly complete barrenness of even big blocks of the latter, almost any piece of acidic rock is likely to be practically covered with lichens. The following were collected on the area of the quadrat listed above, and include some whose growth had been much influenced by manuring of a spot in the shelter of one boulder by ptarmigan, which suggests that in common with most arctic areas this one is markedly deficient in food salts:

Lecidea dicksonii
L. lulensis
L. pantherina var. *achariana*
Rhizocarpon chionophilum
R. geographicum
Sporastatia testudinea
Umbilicaria lyngei

Cliffs and steep slopes are much less common and important around Arctic Bay than in the other places considered above. They occur chiefly on the coast but sometimes also inland on hills, the commonest case being where a fast-weathering crag gives rise to a long scree. In both situations the face is largely barren when dynamic, but when stabilized may be occupied by almost any one of the communities inhabiting dry areas in the district. Thus, on the mountain mentioned above, fully closed communities persisted in many places on steep scree and other slopes to an altitude of nearly 1,500 feet (457 m.), and undoubtedly played an important part in their continued stabilization, just as the forerunners of these communities may be expected to have done in first bringing

the screes to a standstill. Even above 1,500 feet there were to be found quite luxuriant patches of *Dryas* or *Salix arctica* and Luzulae, bound by various mosses, while *Cassiope tetragona* still dominated sheltered depressions. Indeed most of the hardier dry-land plants of the plains were to be found persisting to this altitude.

(ii) LOWLANDS

As has already been mentioned, many exposed lowland areas are occupied by one or another kind of *Saxifraga oppositifolia* or *Dryas integrifolia* "barren", or by similar (often mixed) communities. Thus on some raised gravelly banks near the sea, from which the lowest appeared to have emerged only in quite recent times, the community in both composition and development may be closely comparable with that listed above from the top of a mountain; whereas in sheltered depressions that are well covered with snow in winter, a characteristic dark *Cassiope* heath is generally developed (*See* below). The vegetation is almost always poorer on the limestone tracts, other factors of the habitat being similar. Marshes of one sort or another also cover considerable areas on the flats and more gentle slopes in the manner to be described later, leaving only the more luxuriant dry-land communities of the lowlands to be discussed here.

PLATE XVIII

Luxuriant south-facing "flower slope". In the foreground are seen tufts of *Dryas* in fruit; on the right, characteristic large rosettes of *Oxytropis maydelliana*, and on the left, below the rucksack, *Astragalus alpinus*. The "grassiness" is due principally to species of *Carex*. Arctic Bay, N. Baffin, Sept. 11, 1936.

The first and perhaps most remarkable of these is developed on fairly slight slopes near the sea—not low down by the water so much as behind, underneath the crags or low cliffs. It appears to be a kind of glorified *Dryas* barren, as *Dryas* is the usual dominant (covering up to half the area) and the vegetation is at most not properly closed; it is chiefly remarkable, however, for the frequency or even abundance of associated leguminous plants of good growth

(*See* Plate XVIII) and of small Cyperaceae, which latter make these areas look straw-coloured from a distance. The community varies greatly in luxuriance and considerably in composition from spot to spot, the following being the components of one 4-metre quadrat:

SPERMATOPHYTA	*Dryas integrifolia*	a-vad
	Carex rupestris	a
	C. nardina var. *hepburnii*	o-la
	Kobresia myosuroides (*K. bellardi*)	f
	Oxytropis maydelliana	f
	Polygonum viviparum	f
	Salix arctica	f
	Carex misandra	r-f
	Astragalus alpinus	o
	Pedicularis lanata	o
	Cerastium alpinum	r
	Hierochloe alpina	r
	Papaver radicatum	r
	Pedicularis capitata	r
	Saxifraga oppositifolia	r
	Oxyria digyna	vr
	Pedicularis hirsuta	vr
MUSCI	*Campylium polygamum*	
	Ditrichum flexicaule	
	Hypnum bambergeri	
	H. vaucheri	
	Tortula ruralis	
LICHENES	*Caloplaca elegans*	
	Cetraria cucullata	
	C. islandica	
	C. nivalis	
	Fulgensia bracteata[1]	
FUNGUS	*Clitocybe rivulosa*	

The soil was highly calcareous, effervescing violently with cold HCl, although in places dark with admixed shale. It contained a preponderance of finely comminuted silt or clay particles and, being apparently so damp deep down as to be subject to disturbance by solifluction, had a smooth "hard-baked" surface. A result was that the cryptogams were generally of poor growth, and although in places they were important as "fillers", as also was *Salix arctica*, they more often left the patches of earth quite bare between the higher plants. More numerous than the terricolous macrolichens were the crustaceous species on those of the occasional larger projecting rocks that appeared to be less affected than others by solifluction, whose disturbing action may well have been the sole factor keeping the community open. In spite of this, growth of many of the forbs, including both of the leguminous species, was unusually luxuriant, the whole of this particular south-facing slope being more reminiscent of a Spitsbergen or Novaya Zemlya "flower hill" than anything else I have seen so far north in the New World. It accordingly seems probable that the leguminous plants benefit the whole community, as well as themselves, by their nitrogen-fixing activities. The lack of any true grass was remarkable; plant biologists should note that there were nevertheless three species of *Pedicularis*, all of good growth.

The only other type of vegetation that need be considered here is that which, to my mind, represents the highest the land supports, at least on dry areas under present climatic conditions: this is the "blueberry heath postclimax" developed on especially favourable, well-drained, south-facing slopes in sheltered situations. Areas of this are much more frequently encountered, and tend to be more extensive, than at Dundas Harbour; nevertheless the general type and

[1] *See* Part II, p. 360, footnote (2).

composition are so closely comparable with those of the Dundas example listed on pages 45-6 that it would be superfluous to give more than a few notes of comparison here. Thus, even the rarer associates such as *Tofieldia coccinea* and *Carex scirpoidea* occur in (and are still largely confined to) these areas at Arctic Bay, where, however, we must add as frequent associates *Pyrola grandiflora* and *Oxytropis maydelliana*, which are both unknown on Devon Island.[1] The soil is again rich, dark, and largely of humus; but the control of the dominants tends to be much stronger in the southern station, where the number especially of casual associates is correspondingly reduced. This accords with what is probably the most significant difference, viz., that at Arctic Bay, occasionally and very locally on the most favourable and sunny, south-facing slopes, the *Vaccinium* may oust almost all phanerogamic associates and entirely dominate the area—to the exclusion even of *Cassiope*. It seems probable that climatic conditions, in particular the summer temperatures, are more favourable in this part of Baffin than at Dundas or Pond Inlet (*See* above).

(iii) MARSHES

The closed marshy areas that cover so large a proportion of the land surface around Arctic Bay, although they are almost constant as regards the dominants and co-dominants,[2] nevertheless exhibit a considerable range of variation in their

PLATE XIX

Freshwater lake and luxuriant marginal marsh dominated by Carices, Eriophora, and *Arctagrostis latifolia,* showing colonization of sheltered bay in foreground. Arctic Bay, N. Baffin, Sept. 10, 1936.

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[1] Simmons's report (1913, p. 115) of "Pyrola rotundifolia" from "North Devon: Northumberland Inlet, Sutherland" is erroneous (*See* Polunin 1936a, p. 411). Another interesting plant that is not known to occur at Dundas Harbour (though it probably does), but may be found on open spots in the heaths at Arctic Bay, is the diminutive *Arenaria humifusa*, whose supposed phytogeographical significance may well be due merely to its *insignificance* and weakness in the face of competition (cf. Polunin MS.d and MS.f).

[2] I.e., of the four species listed below as liable to be "vad" or "lacod," one or two are generally dominant in any marshy area, as at Dundas, and the others are almost invariably to be found in any considerable tract of this type.

luxuriance, and in the depth of their "soil", which is probably a function of age. The most luxuriant marshes have a deep boggy substratum and are typically developed around the margins of lakes, behind which they may persist as far as the area remains flat. Willows of upright, bushy growth being absent from the vicinity, it is here that the tallest plants of the district are to be found—generally *Arctagrostis latifolia,* which occasionally exceeds 50 cm. in height.

PLATE XX

Poorer type of marsh, characterized by *Eriophorum angustifolium* (white heads), developed on slight slopes. On the side of the ridge to the right, the community thins away to *Dryas* and ultimately *Saxifraga oppositifolia* "barrens". Arctic Bay, N. Baffin, Sept. 9, 1936.

A typical example of such a marsh is seen in Plate XIX where, excluding the aquatic and semi-aquatic communities, which will be treated under the appropriate heading, the floristic composition is very similar to that found in the poorer marshes that occupy many gentle slopes in depressions between hills and ridges (cf. Plate XX), sometimes where both altitude and drainage are considerable. It is true that Sphagna are largely confined to the deeper, stagnant "bogs", where also the dominance of certain species tends to be more marked and the associates correspondingly reduced in range and numbers, but the general similarities of these areas with the more extensive "young" marshes of percolating water are such that I have thought best to combine my lists from examples of the two types, the result being as follows:

VASCULARES	*Carex aquatilis* var. *stans*	a-vad	
	Arctagrostis latifolia	o-vad	
	Carex membranacea	f-lacod	
	Eriophorum angustifolium	o-lacod	
	E. scheuchzeri	r-la	
	Dupontia fisheri	absent-la	
	Hierochloe pauciflora	f	
	Salix arctica	f	chiefly on drier tussocks

Pedicularis sudetica	r-f	
Saxifraga hirculus	r-f	
Carex misandra	o	on dry tussocks
Polygonum viviparum	o	
Saxifraga cernua	o	
S. stellaris var. *comosa*	o	
Juncus biglumis	r-o	
Luzula nivalis	r-o	
Poa arctica	r-o	
Carex atrofusca	absent-o	
C. bipartita	absent-o	
Equisetum variegatum	absent-o	
Arenaria uliginosa	r	
Cardamine pratensis var. *angustifolia*	r	in fruit
Carex rupestris	absent-r	on dry tussocks
Draba fladnizensis	absent-r	
Eriophorum cf. *chamissonis* x *scheuchzeri*	absent-r	
Stellaria longipes	absent-r	
Lychnis apetala	vr	
Deschampsia brevifolia	absent-vr	
Pedicularis hirsuta	absent-vr	
Draba alpina var. *nana*	(1)	on dry tussock
Eutrema edwardsii	(1)	

The soil is deep, dark, and humous in the "bog", but shallow in the fresh young marsh; it is moss-bound almost everywhere and very damp except where raised into hummocks, which are often 20 cm. high and largely topped by *Salix arctica, Carex misandra,* and Cladoniae. The subdominant mosses, which in most places form an almost continuous investment except in muddy or peaty depressions where some aquatic species nevertheless persist, are mixed and variable. Some lichens and a number of parasitic and other Fungi also occur, although the latter are rather rare. The most important or notable cryptogams are as follows:

Musci	*Aulacomnium turgidum*	a
	Drepanocladus revolvens	a
	Orthothecium chryseum	a
	Calliergon giganteum	f
	Campylium stellatum	f
	Breidleria arcuata	
	Dicranum groenlandicum	
	Ditrichum flexicaule	
	Drepanocladus sendtneri	
	Meesea triquetra	
	M. uliginosa	
	Orthothecium rufescens	
	Polytrichum alpinum	
	Sphagnum squarrosum	
	Tomenthypnum nitens	
Lichenes	*Cetraria cucullata*	
	C. nivalis	
	Cladonia elongata	
	C. pyxidata var. *neglecta*	
	C. uncialis	
	Cortinarius incisus	
	Stereocaulon sp.	
Fungi	*Calvatia fragilis*	
	Cintractia caricis on *Carex rupestris*	
	Lycoperdon furfuraceum	
	Melampsora bigelowii on *Salix arctica*	
	Sphaerospora trechispora	

(iv) SNOW EFFECT

In depressions and on many sheltered slopes where the surface is stable and the snow drifts rather deeply in winter, melting so gradually in summer that the growing-season of the area is appreciably though not drastically reduced, *Cassiope* is almost invariably dominant as in the Far North. In the more favourable (especially south-facing) but relatively early melting areas there may be a considerable admixture of *Vaccinium uliginosum* var. *alpinum,* as was the case at Dundas Harbour, whereas in areas that merely have a good protective snow-covering in winter the associates may include many "barrens" or marsh species, according to the local water and other conditions. Very considerable tracts of lowland country around Arctic Bay are occupied by one or another of these poorer, mixed heathy communities—especially in depressions, however slight these may be, where the *Cassiope* generally exerts more control than elsewhere, and darkens the terrain appreciably.

The following lists were taken from a small area (about 7 square metres) of relatively luxuriant *Cassiope* heath occupying the lower slopes of a sheltered ravine, the *Cassiope* being up to 10 cm. high and, as is frequently the case, so overwhelmingly dominant that most of the associates were scarcely apparent, although quite numerous species were present. Even the Salices acted, as indeed they most frequently do also in other habitats, merely as "fillers":

VASCULARES	*Cassiope tetragona*	vad
	Carex misandra	f
	Salix arctica	f
	S. reticulata	f
	Carex bigelowii	o
	Draba fladnizensis s.l.	o
	Luzula nivalis	o
	Pyrola grandiflora	o
	Vaccinium uliginosum var. *alpinum*	o
	Arctagrostis latifolia	o
	Carex scirpoidea	o
	Oxyria digyna	r-o
	Pedicularis hirsuta	r-o
	Dryas integrifolia	r vegetative only
	Lycopodium selago	r
	Poa arctica	r
	Pedicularis capitata	r
	Stellaria longipes	r
	Draba nivalis	vr
	Tofieldia coccinea	vr
	Hierochloe alpina	(1)
	Saxifraga oppositifolia	(1) vegetative only
	S. tricuspidata	(1)
MUSCI	*Aulacomnium turgidum*	
	Campylium stellatum	
	Dicranum scoparium	
	Drepanocladus uncinatus	
	Hylocomium splendens	
	Oncophorus wahlenbergii	
	Orthothecium chryseum	
	Rhacomitrium lanuginosum	
	Tomenthypnum nitens	
HEPATICAE	*Blepharostoma trichophyllum*	
	Lophozia alpestris	
	L. barbata	
	L. harpanthoides	
	L. quadriloba	
	Ptilidium ciliare	
LICHENES	*Cetraria cucullata*	
	C. islandica	
	Stereocaulon alpinum	

The bryophytes, particularly, were numerous and variable and showed the local incidence of marsh and late-snow microfacies, the terrain being in places somewhat broken. The soil was rather damp and dark, and almost exclusively of humus between the morainic boulders that formed the substratum. Over the smooth, rounded tops of these boulders the investment was bound by living roots and remained rather thin, though generally continuous in spite of the inhospitable surface. After possible early proseral stages, the xerosere probably progressed chiefly as a result of chomophytic activity (cf. Polunin 1936, pp. 380-1); however this may be, the vegetation has certainly managed to take a good hold, as is often the case over considerable areas around Arctic Bay, in contrast with the situation in most places farther north.

PLATE XXI

Late-snow depression in gravelly moraine. On the sunny bank to the left is seen a dark outer zone of *Cassiope* heath, whereas the north-facing slopes on the right are vegetated by poorer communities. Arctic Bay, N. Baffin, Sept. 11, 1936.

Of lesser importance, at least in the lowlands where they cover only a very small proportion of the area, but nevertheless distinctive and characteristic, are the real late-snow patches, where the snow drifts so deeply in winter that the growing-season just here is drastically reduced by its late melting in summer. In the uplands such areas are relatively frequent, but limited as regards possible colonists; in the lowlands they are best seen on gravelly moraines where a defunct stream has cut a gully or ditch that tends to be filled with snow in winter. An example is shown in Plate XXI, which also illustrates how surrounding areas that have a deep but less long-lasting snow-covering are generally vegetated by *Cassiope* heath. This heath is seen to the left although, lying as it does on a raised bank, it is here unusually poor and lichenous. However, on the north-facing slopes seen to the right in this photograph, the *Cassiope* is

generally unable to vegetate successfully, and its place is taken by a *Dryas*- and *Salix*-rich community of a lighter colour and lower life-form. Salices (especially *S. reticulata*[1]) also tend to form a zone between the *Cassiope* and the late-snow area proper.

The soil toward the centre of these late-snow areas, e.g., on the lowest slopes and in the bed (which once held a stream) in Plate XXI, is most typically of light-coloured mineral "earth" containing little or no humus except near the surface. Above, it may be stained by leaching from the litter or encrusted deposit which frequently accumulates on the surface, and which may result not merely from the decay of plants *in situ* but also from litter blown on to the snow that covers such areas during most of the year. In these late-snow patches growth is usually poor, the community being open; however, the plant colonists may be many and very variable, as will be seen from the following list[2] made from an area 8 m. long and 4 m. broad that lay along the gully shown in Plate XXI:

SPERMATOPHYTA *Alopecurus alpinus*
Arctagrostis latifolia
Arenaria rossii
A. rubella
Cardamine bellidifolia
**Cerastum alpinum*
C. beeringianum?
Draba alpina var. *nana*
D. fladnizensis s.l.
Eutrema edwardsii
Juncus biglumis
Luzula confusa
L. nivalis
Oxyria digyna
**Papaver radicatum*
Pedicularis hirsuta
Phippsia (Catabrosa) algida
Poa arctica
Polygonum viviparum
Potentilla hyparctica (P. emarginata var. *typica)*
Ranunculus nivalis
**R. sulphureus*
Salix arctica
S. reticulata
Saxifraga caespitosa
S. cernua
S. hieracifolia
S. hirculus
S. nivalis var. *tenuis*
S. rivularis
S. stellaris var. *comosa*
Stellaria longipes

Between the Spermatophyta, most of which are either dwarfs by nature or remain rather small, Bryophyta in places cover the ground, especially where it is of fine silt and most lastingly damp. The Musci are of poor growth, much mixed, and with a few exceptions appear hardly ever to fruit. Occasional Lichenes and Fungi are also to be found:

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[1]As on Akpatok Island, cf. Polunin (1934, p. 387, and Pl. XXXVIII photo 34).

[2]The habitat and community being far from uniform from spot to spot, except in their "late-snow" nature, it is thought best to give the species in alphabetical order and without frequency degrees. Those most generally abundant were *Alopecurus*, *Phippsia* (*Catabrosa*), and *Luzula confusa*.

*Still in flower on September 11, 1936.

BRYOPHYTA	*Aulacomnium turgidum*
	Blepharostoma trichophyllum
	Calliergon sarmentosum
	Campylium stellatum
	Dicranum elongatum
	Distichium capillaceum
	Ditrichum flexicaule
	Drepanocladus revolvens
	Orthothecium chryseum
	Pohlia cruda
	Psilopilum laevigatum
	Ptilidium ciliare
	Timmia austriaca
LICHENES	*Ochrolechia frigida*
	Stereocaulon sp.
FUNGUS	*Omphalia umbellifera*

(v) SPECIAL LOCALIZED HABITATS AND COMMUNITIES

Apart from some examples low down near the sea, which are obviously still affected by their recent emergence therefrom, the raised beaches around Arctic Bay, like those of most places to the south, do not call for special mention as they support (and are indeed generally obscured by) one or another of the usual land communities described above.

More noteworthy are the numerous, almost straight dykes of dark diabase that cut the usual sedimentary rocks at rather frequent intervals and that, weathering less rapidly than the surrounding material, stick up conspicuously in many places. Two such ridges, less regular in outline than is frequently the case, are seen in the middle distance in Plate XXII, which was actually taken from the top of another dyke, and, accordingly, shows in the foreground the typical grassy-healthy vegetation developed on such irregularly broken areas. The diabase splits chiefly into square blocks, the surface weathering into a coarse sandy "soil" that accumulates in pockets and generally supports a more luxuriant and mixed community than most areas around, especially when these are of basic-weathering rocks. Quite frequently these pockets are occupied by *Cassiope tetragona* or *Vaccinium uliginosum* var. *alpinum*, or else by mosses (especially *Rhacomitrium lanuginosum*) on which grow *Hierochloe alpina*, *Festuca brachyphylla*, or Salices. Also characteristic of these dykes are *Luzula confusa* and *Saxifraga rivularis*, which are generally absent from the surrounding limestone areas.

Solifluction is the movement of earth and other solid material on, e.g., frozen subsoil or rock surfaces. It takes the form generally of an imperceptibly slow flowing, or sliding, down slight slopes, whose surface is as a result somewhat disturbed, although usually remaining sufficiently static to support some sort of vegetation. The phenomenon is particularly prevalent around Arctic Bay, with its many gentle slopes, although occurring in most arctic and many high-alpine regions. Thus the "flower slopes" listed on page 69 appeared to be somewhat disturbed by solifluction, to judge from the frequent patches of "fresh" bare earth to be met with in the less luxuriantly vegetated places; indeed, solifluction alone is here probably sufficient to prevent colonization by heaths for the (probably thousands of) years until the valley becomes filled or the crags supplying the moving material have become eroded right down. Another example of a solifluction slope is seen in Plate XXIII, which shows (in the background) typical surface corrugations extending down the slight slope, to the right. The variable vegetation, whose appearance is accentuated by rime, is largely confined to the depressed furrows, although they are only a few centimetres lower in level

PLATE XXII

In the foreground is luxuriant mixed grassy-heathy vegetation on a raised diabase "dyke". Two other such dykes are seen in the middle distance. The land is typical of the rather low rolling country bordering the central and southern parts of Admiralty Inlet. Arctic Bay, N. Baffin, Sept. 9, 1936.

PLATE XXIII

Slight slope exhibiting solifluction phenomena, viz., corrugation of the surface longitudinally downwards, the vegetation being largely confined to the furrows, and, in the foreground, the thrusting up of a boulder and patch of bare earth. Arctic Bay, N. Baffin, Sept. 9, 1936.

than the accompanying ridges. In the foreground is a large boulder that appeared to have been thrust up to the surface only a few months or even weeks previously, to judge by the cavity left at one side and the fresh and completely barren earth remaining around it. Such local disturbances are common in arctic lands.

Finally, we must mention the anthropic influence that in and near Arctic Bay has led to the appearance of occasional swarded grassy areas around encampments, some of which were still inhabited in 1936 by a few Eskimos and a greater number of sledge-dogs. On one such area the sward consisted almost entirely of *Alopecurus alpinus*, the chief re-disturbing influence being the biotic one, which had produced patches of dark earth in some places. These were often invested with a fine growth of the green Alga *Prasiola crispa*, which is especially characteristic of these almost constantly manured spots, and consequently comes to form a delicate green mat behind tents. The chief "flowers" here were *Potentilla nivea* and *Saxifraga cernua*. Relatively recent, but now ruined, early-winter dwellings at the head of the bay, constructed of calcareous earth, stones, and the bones of whales, had growing on their doomed, clayey sides much *Agropyron violaceum* var. *hyperarcticum* and *Erysimum pallasii*, neither of which had been found in the region before, although both subsequently turned up far enough away to settle my previous doubts about their having been possibly introduced. Another uncommon plant growing on the clayey plains around these dwellings was *Lesquerella arctica*, and there was here also plenty of *Puccinellia angustata* and *P. vahliana*.

(vi) FRESHWATER

Freshwater habitats and communities are many and variable around Arctic Bay, though only sufficient examples will be mentioned to give some idea of their range and type. Many of them are more luxuriant than anything of the kind seen to the north. Thus, Plate XXIV shows a sluggish stream meandering through a marsh dominated by tall *Dupontia fisheri* toward the bottom of a series of gently sloping and well vegetated "raised beaches" near the sea. The bed of the stream supported brown aquatic mosses, as did most of the lakes and marshy depressions around. On submerged stems of *Carex aquatilis* var. *stans* growing in a shallow part of the stream there were the following small Algae, forming a greenish brown flocculent investment during the second week of September in 1936:

Achnanthes flexella
A. minutissima var. *cryptocephala*
Amphora coffeaeformis
A. ovalis var. *typica*
Caloneis silicula var. *alpina* and var. *subundulata*
Cosmarium botrytis
C. holmiense
C. meneghinii
C. parvulum
C. punctulatum
C. subcrenatum
Cyclotella antiqua
Cymbella aequalis
C. angustata var. *hybrida*
C. botellus
C. cesatii
C. cistula var. *eucistula*
C. cuspidata
C. scotica var. *incerta*
C. stauroneiformis
C. subaequalis var. *oblonga*

C. tumidula
C. turgida
C. ventricosa var. *genuina*
Denticula tenuis var. *intermedia*
Diatoma tenue var. *pachycephalum*
Diatomella balfouriana
Eunotia pectinalis var. *stricta*
E. praerupta var. *genuina*
Gomphonema mustela
Gomphosphaeria aponina
Melosira sulcata
Merismopedia tenuissima
Navicula muralis
N. radiosa var. *tenella*
N. tuscula
N. vulpina
N. zellensis var. *linearis*
Neidium bisulcatum
Nitzschia amphibia
N. denticula
N. frustulum
N. sinuata
N. subtilis var. *genuina*
Pinnularia abaujensis
P. microstauron
Staurastrum muticum
Stauroneis perpusilla var. *obtusiuscula*
S. phoenicenteron var. *amphilepta*
Synedra amphicephala
S. pulchella
Tabellaria fenestrata
T. flocculosa

PLATE XXIV

Sluggish stream flowing through dense marsh (dominated by ***Dupontia fisheri***) toward bottom of a well-vegetated raised beach system near the sea. The mountain in the distance is the one whose summit vegetation is described on pages 66 *et seq.*, and is perhaps the tallest in the region. Arctic Bay, N. Baffin, Sept. 9, 1936.

In swifter streams many of the same *microscopicae* occurred, but mosses when present were generally greener, and such filamentous Algae as *Ulothrix zonata* were often to be found in plenty—also *Zygnema* sp. (sterile) in eddies and on damp mud. On the other hand, the more ephemeral and often much larger streams that carry the run-off when the snow melts in early summer have their broad and open, generally bouldery beds more or less barren, although occasional plants of very various kinds can occur here and there. From the margin of one such stream, where inundation was probably for only a brief period at snow-melt, I collected on a few of the larger boulders the following thirteen crustaceous or foliose lichens, which still did not nearly exhaust the great range of species to be observed:

Acarospora molybdina
Buellia microplaca
Caloplaca elegans
Lecanora canadensis
L. polytropa var. *leucococca*
Lecidea atrobrunnea
L. dicksonii
L. elata var. *marginata*
L. tesselata
Omphalodiscus virginis
Rhizocarpon disporum
R. geographicum
Rinodina hueana

Some idea of the conditions and vegetation obtaining around the more favoured lakes of the district is afforded in Plate XIX, which also shows the colonization of open water in a sheltered bay by the marginal dominants, in particular *Eriophorum* spp. and *Carex aquatilis* agg. Elsewhere the exposed margin of this lake was bounded by a rampart or "hard line" of mosses (particularly *Sphagnum squarrosum*) held by interwoven grass or sedge roots and maintained by the hard beating of the waves. However, most of the lakes are smaller and have shelving, muddy or gravelly margins that are liable to be invaded by any of the usual marginal dominants or important associates, including *Arctagrostis latifolia* and *Dupontia fisheri*. The beds of the lakes, at least where they are of suitable gravel, are vegetated by aquatic mosses such as *Breidleria arcuata*, and by *Ranunculus trichophyllus* var. *eradicatus*, whose glistening white (and here generally prostrate) axes can be seen extending down even to where the water is more than a metre deep. In one such situation I saw a little *Hippuris vulgaris* growing under ice, and frequently *Pleuropogon sabinii* forms beds with leaves floating on the surface, although their bases may be rooted more than 50 cm. down. On such submerged plants and on stems of *Carex aquatilis* agg. were found, during the second week of September, 1936, the following small Algae[1]:

Aphanothece stagnina
Cosmarium granatum var. *subgranatum*
C. phaseolus
C. rectangulare
C. reniforme
C. subcrenatum
C. tetragonum
C. turpinii
C. undulatum
Merismopedia glauca
Oocystis naegelii
O. nodulosa
Tolypothrix tenuis

[1] This list and the next are much shorter than the algal ones immediately preceding and following them, largely on account, probably, of the Diatomeae not having been identified in the samples on which the former pair of lists are based—*See* Introduction, p. 5.

Floating masses of organic material, including many green and brown living cyanophycean colonies, yielded the following considerable list:

Ankistrodesmus falcatus
Aphanocapsa grevillea
Clastidium cylindricum
Cosmarium holmiense var. *integrum*
C. phaseolus
C. rectangulare
C. reniforme
C. speciosum
C. tetragonum
C. triselionatum
C. turpinii var. *eximium*
C. undulatum
C. viride
Desmidium swartzii
Lyngbya pusilla (epiphytic on *Oedogonium* sp.)
Merismopedia punctata
Microspora willeana
Nostoc aureum
Oedogonium sp.
Staurastrum inflexum
S. muticum
Tolypothrix tenuis

Forming collectively reddish brown or green masses on damp mud and other surfaces around the margins of lakes in the second week of September, where the water had doubtless been higher earlier in the summer and even now was apt to "wash," the following were found in 1936:

Achnanthes flexella
A. minutissima var. *cryptocephala*
Amphora ovalis var. *affinis*
Aphanocapsa pulchra
Aphanothece saxicola
Caloneis bacillaris
C. silicula var. *alpina*, var. *genuina*, and var. *subundulata*
Ceratoneis arcus
Chroococcus turgidus
Closterium cynthia
C. venus
Cosmarium anceps
C. bioculatum
C. botrytis
C. cucurbita
C. granatum
C. holmiense
C. quadratum
C. speciosum var. *simplex*
C. subcucumis
C. subexcavatum var. *ordinatum*
C. subtumidum
Cyclotella antiqua
Cymbella aequalis
C. angustata var. *hybrida*
C. botellus
C. cistula var. *arctica* and var. *eucistula*
C. cuspidata
C. gastroides
C. heteropleura var. *minor*
C. scotica var. *incerta*
C. stauroneiformis
C. subaequalis var. *oblonga*
C. turgida
C. ventricosa var. *semicircularis*

Denticula tenuis var. *intermedia*
Diatomella balfouriana
Diploneis oblongella var. *oblongella* and var. *ovalis*
Euastrum didelta
Eunotia arcus
E. fallax var. *typica*
E. papilio
E. pectinalis var. *stricta*
E. praerupta var. *genuina*
Gomphonema angustatum var. *aequale* and var. *undulatum*
G. intricatum
G. mustela
G. truncatum
**Merismopedia glauca*
Microcoleus vaginatus
Navicula bacilliformis
N. bacillum
N. pupula
N. tuscula
N. vulpina
Neidium affine var. *capitatum*
N. amphigomphus
N. kozlowi var. *parvum* and var. *typicum*
Nitzschia amphibia
N. denticula
N. dubia
N. sinuata
N. vitrea
Nostoc commune
**Oscillatoria tenuis*
**Phormidium inundatum*
Pinnularia biceps f. *biceps* and f. *petersenii*
P. brandelii
P. cleveana
P. divergens var. *genuina*
P. mesolepta var. *stauroneiformis*
P. spitsbergensis
Staurastrum brachycerum
S. cyrtocerum var. *compactum*
**S. hexacerum*
S. subvarians
Stauroneis anceps var. *amphicephala*
S. phoenicenteron var. *amphilepta* and var. *genuina*
Synedra minuscula
S. ulna var. *genuina*
Tabellaria fenestrata
Tolypothrix distorta var. *penicillata*
T. limbata
T. tenuis

Where the water disappears completely the surface on drying may crack into little irregular "polygons," which consist largely of organic material and are hence usually dark brown or almost black. The cyanophycean colonies, particularly, appear in this manner to result in quite rapid humous accumlation—most notably in the shallow ephemeral pools with silty beds that are so frequent in marshy situations or slight depressions almost everywhere in the Arctic, where a permanently frozen subsoil impedes or prevents drainage.

(vii) SEASHORE

The shores around Arctic Bay, where the tide range is very small, are chiefly of sand or shingle that is unbound and generally quite barren. Neither *Elymus* nor *Mertensia* was to be found, and *Arenaria peploides* appeared to be very rare,

* In scrapings from rocks.

being seen only twice in many miles of travelling along shores that looked eminently suitable for the ecesis of all these three plants. However, in the more muddy places *Puccinellia paupercula* and *P. phryganodes* were generally to be found—the latter sometimes forming beds of considerable extent—and in sheltered situations such as the margins of lagoons a fair saltmarsh community occurred. The chief dominant was, as elsewhere, usually *Puccinellia phryganodes.* This formed a close sward, generally with much *Carex ursina* and *Stellaria humifusa,* and, toward the drier margin in a few places, *Koenigia islandica* and *Arenaria rossii.* Such green Algae as, in two examples, *Enteromorpha ramulosa* were often abundant in brackish or tidal lagoons.

The communities around low tide-mark were not investigated but in one place it could be seen that Fuci predominated, forming quite luxuriant "mats." No large laminarians were observed, but presumably beds of them occur where the substratum is suitable for their holdfasts.

Plant Communities Around Pond Inlet "Post"

Pond Inlet is the strait running in a westerly direction from the open sea of Baffin Bay to Eclipse Sound in northern Baffin, from whose northeastern mainland it separates the south coast of Bylot Island. More popularly, the name is applied to the administrative and trading centre that is situated on the south shore of the strait in latitude 72° 43′ N., longitude 77° 45′ W. Here the Hudson's Bay Company have their northernmost permanent post, as do the missionary services of the Church of England in Canada and the Roman Catholic Church; there is also an R.C.M.P. detachment which through World War II was the farthest north to remain occupied. The total population is about nine whites and over a hundred Eskimos. As with almost all other such "posts" in the Canadian Eastern Arctic, there is only one supply ship each year —nowadays always the R.M.S. *Nascopie.*

Although quite high mountains, often accompanied by glaciers, are to be seen in the distance almost all around, the land for some miles behind Pond Inlet post is low and rolling (generally 100 to 250 feet above sea-level). These plains consist almost entirely of upraised marine terraces composed of rewashed glacial material. There is a considerable admixture of sand and fine gravel, and the terraces often appear on the surface of the plains as low beach ridges. Marine shells are not particularly frequent; nor were limestone boulders at all noticeable. In fact, the country as a whole has a rather dark and dreary aspect, being almost everywhere brown or grey rather than green (cf. Mathiassen 1933, p. 56). The bedrock around is Archæan, of contorted gneisses that are often garnetiferous. Nor does the soil, in any example that I tested, show anything but an acid reaction and complete apathy to cold HCl.

Some details of the climate at Pond Inlet post have already been given; suffice it to add here that in spite of the existence of much high land around, it is a very exposed and windy spot, as well as a very foggy one.

My visits to this place, which was so well known to the old-time whalers, have been several but very brief. I have, however, been able to survey the vegetation in some detail, as the local range of habitats and communities tends, with the predominantly low country and marine origin of the surface material, to be less extreme and variable than in most northern districts. Perusal of the resulting voluminous notes shows that the vegetation is in general so closely comparable with that of Arctic Bay, described above, that I will here largely confine myself to pointing out such differences as have been noted between these two areas in the same major district.

(i) HILLS AND RIDGES

The country being rather low and featureless, these are small and, especially near the sea, tend to be very poorly vegetated. The usual community, if such it may be styled, is a *Saxifraga oppositifolia* "barren" in which quite a close search may be needed to reveal any vascular plants—cf. Plate XXV of such an area, although in this example there is to be seen on the top of the ridge a dense grassy sward developed around one large boulder for reasons that will be explained below. Thus the vegetation may be almost as poor as that described from the mountain top at Arctic Bay, and its composition may also be very similar. Generally, however, the flora is larger, the most characteristic additions among the angiosperms being *Salix arctica, Carex nardina, Festuca brachyphylla, Luzula confusa,* and *Dryas integrifolia.*[1] The soil remains gritty, almost entirely devoid of humus, and not markedly acid. That the barrenness is due to a combination of factors of exposure and lack of food-salts is demonstrated by the greatly increased luxuriance where either of these inhibitors is removed—e.g., by the appearance of the dense sward around the large boulder in Plate XXV, due to manuring, and by the immediately more luxuriant vegetation developed in almost any sheltered depression, however small. Already on the sides of the morainic hills and gravelly ridges the vegetation is less depauperate, generally containing much *Dryas,* while on their lower slopes it merges into the still more luxuriant (usually closed) communities of the general plains.

(ii) GENERAL SURFACE OF PLAINS

Most of the less exposed surfaces of the plains support a continuous covering of vegetation, being occupied by rather damp mixed tundra or by drier, but still mixed, heathy communities. The former type may perhaps represent the climax under present climatic conditions (as has already been suggested for rather similar formations more than once before when dealing with other areas), but I am not at all sure that, with sufficient humous deposition, it could not pass into the latter—in spite of the fact that this is as yet largely confined to slopes and dry banks. Hence the damper tundra may be no more than a preclimax.

The damp tundra covers considerable areas of the lower lying, more sheltered flats and broad, open valleys. It is mixed and variable from place to place, being typically rather tussocky in the manner shown in Plate XXVI. The tussocks of this "hillock tundra" are best developed in stagnant areas and are generally 20-30 cm. high. They supposedly result from frost action, at least indirectly. Thus the damp ground freezes from the surface downwards, so pressing the lower layers against the permanently frozen subsoil that cracks may occur here and there and semi-liquid material be squeezed out of them. This may be the incipient hillock and become colonized by mosses of tussocky growth, which in time may greatly accentuate it. It is largely because of these tussocks that the community is so much mixed, for they introduce all manner of micro-habitats. Thus the depressions between the tussocks may be wet and peaty—often actually under water for much of the summer—and very poorly vegetated. Their sides, too, support marsh plants for the most part. The tops of the tussocks, on the other hand, may be largely covered by heaths or the

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[1]The cryptogams may be far more numerous, especially if we include slight depressions, the Pond Inlet 'additions' (i.e. to the Arctic Bay list) including:

MUSCI *Polytrichum piliferum*

HEPATICAE *Chandonanthus setiformis, Lophozia muelleri*

LICHENES *Cetraria crispa, C. cucullata, C. nivalis, Cladonia mitis, C. pyxidata* var., *Cornicularia divergens, "Ochrolechia tartarea". Sphaerophorus globosus, Stereocaulon alpinum, Thamnolia vermicularis.*

Plate XXV

Saxifraga oppositifolia "barrens" on exposed ridge near the sea. The grassy sward around the boulder is due to manuring. Pond Inlet, N. Baffin, Sept. 12, 1934.

Plate XXVI

"Hillock tundra" developed in damp stagnant area. It comprises an intricate mixture of marsh and heath species. Pond Inlet, N. Baffin, Sept. 12, 1934.

more xerophytic Carices. The following list, made from one small area of this damp mixed tundra, shows how various are the elements included in the community, and how it may lack any true dominant or even co-dominants; species that are largely or entirely confined to tussocks are starred:

VASCULARES	*Carex membranacea*	f-acod
	Salix arctica	f-acod
	Cassiope tetragona	o-acod
	Eriophorum angustifolium	o-acod
	Arctagrostis latifolia	f
	**Carex misandra*	f
	**Vaccinium uliginosum* var. *alpinum*	f
	Eriophorum spissum	o-f
	Polygonum viviparum	o-f
	Carex aquatilis var. *stans*	o
	C. atrofusca	o
	**Dryas integrifolia* (incl. apprg. f. *intermedia*)	o
	Equisetum arvense	o
	Pedicularis sudetica	o
	**Salix reticulata*	o
	S. richardsoni var. *mckeandii*	o
	Luzula nivalis	r-o
	Braya purpurascens	r
	Equisetum variegatum	r
	Juncus albescens	r
	Oxyria digyna	r
	**Pedicularis lanata*	r
	Salix arctophila	r
	S. herbacea	r
	**Saxifraga oppositifolia*	r
	**Oxytropis maydelliana*	vr
	Saxifraga hieracifolia	vr
	S. nivalis	vr

The tallest plants were occasional specimens of *Eriophorum angustifolium* and *Arctagrostis latifolia*, which reached a height of 35 cm.; this they may exceed in other habitats. The soil was dark and humous only near the surface, but the reaction was distinctly, if only slightly, on the acid side of neutrality (pH 6·4). The cryptogams were also much affected by microclimatic and other factors. Thus lichens were largely confined to the tops of the drier tussocks, where Cetrariae and Cladoniae were much in evidence; hepatics grew best in the damp depressions; mosses were important everywhere, and Fungi parasitic on phanerogamic hosts were unusually common and evident. The following were the chief cryptogams in the area listed, although a much wider range of species can occur in such communities:

MUSCI	*Aulacomnium turgidum*	va
	**Dicranum groenlandicum*	
	Ditrichum flexicaule	
	Drepanocladus intermedius	
	Orthothecium rufescens	
	Sphagnum warnstorfii	
	Tomenthypnum nitens	
HEPATICAE	*Blepharostoma trichophyllum*	
	Lophozia atlantica	
	Ptilidium ciliare	
LICHENES	**Cetraria crispa*	
	C. cucullata	
	**C. nivalis*	
	**Cladonia coccifera* var. *stemmatina*	
	**C. lepidota* f. *stricta*[1]	

* Largely or entirely confined to tussocks.

[1] Not recorded from Pond Inlet in Part II, p. 328.

**C. mitis*
**C. pyxidata?*
**Lopadium muscicolum*
**Parmelia omphalodes*
Psoroma hypnorum
Thamnolia vermicularis

FUNGI *Claviceps purpurea* on *Arctagrostis latifolia*
**Exobasidium vaccinii* var. *myrtilli* on *Cassiope tetragona*
Mycosphaerella lineolata on *Arctagrostis latifolia*
Rhytisma salicinum on *Salix arctica*
Ustilago vinosa on *Oxyria digyna*

A feature of some of these damp tundra areas, especially where they are less disturbed by mossy hummocks, is the bushy growth exhibited by *Salix richardsoni* var. *mckeandii* (*See* Plate XXVII). These bushes are most often 20-55 cm. high (the latter height chiefly inland) and 1-2 m. in diameter, with the tops domed or flat, as the twigs cannot persist above the normal winter snow-blanket.

PLATE XXVII

Domed bushes of *Salix richardsoni* var. *mckeandii* on area of damp mixed tundra covered with new snow. Scale given by author's footmarks. Pond Inlet, N. Baffin, Sept. 19, 1934.

Even in open plains where the snow is mostly blown away, the cumulative effect of some slight outgrowth of the twigs each summer may allow the bushes to become quite large in time; indeed those growing at Pond Inlet are by far the biggest land plants known so far north in the Canadian Eastern Arctic. One old bush, growing near a tarn, was seen to cover an area some 10 m. long and 5 m. wide, the gnarled axes, which had a thick and resistant, corky bark, being up to 4 cm. in diameter.

The "mixed heath" of drier slopes and banks in sheltered situations must also be described in some detail, as it is unlike anything mentioned above. Details vary in different instances but generally the ground, although it may be rendered uneven by projecting boulders, is covered with ground-shrubs inter-

* Largely or entirely confined to tussocks.

rupted by light-coloured lichens (*See* Plate XXVIII). The chief dominant is *Cassiope tetragona*, but other ground-shrubs, including *Ledum palustre* var. *decumbens* and *Vaccinium uliginosum* var. *alpinum*, are usually plentiful. Two 4-metre quadrats, taken at random, gave the following composite list:

SPERMATOPHYTA	*Cassiope tetragona*	a-vad
	Vaccinium uliginosum var. *alpinum*	f-a
	Carex rupestris	f-la
	Luzula nivalis	f
	Salix arctica	f
	Oxytropis maydelliana	o-f
	Dryas integrifolia	r-f
	Ledum palustre var. *decumbens*	o
	Luzula confusa	o
	Polygonum viviparum	r-o
	Saxifraga oppositifolia	absent-o
	Cardamine bellidifolia	r
	Cerastium alpinum	r
	Kobresia myosuroides (*K. bellardi*) (with parasitic *Cintractia caricis*)	r
	Poa arctica	r
	Salix herbacea	r?[1]
	S. reticulata	r?[1]
	Armeria labradorica	absent-r
	Papaver radicatum	absent-r
	Pedicularis hirsuta	absent-r
	Stellaria longipes	absent-r
	Astragalus alpinus	vr
	Festuca brachyphylla	vr
	Saxifraga hieracifolia	vr
	Oxyria digyna	(1)
	Tofieldia coccinea	(1)

PLATE XXVIII

Mixed heath with many lichens. Bushlets of *Ledum palustre* var. *decumbens* are seen to the right and left of the pipe, which gives scale. Pond Inlet, N. Baffin, Sept. 4, 1936.

[1]Frequency degree uncertain as leaves already fallen.

The soil is dark brown and largely of humus at the surface, but grey and gritty below. In reaction it is rather strongly acid for the region, being pH 5·6, and even if it may be quite dry at the surface it is usually damp and tenacious beneath. Over the soil, mosses generally form a layer 3-5 cm. thick in which the liverwort *Gymnomitrium corallioides* is plentiful. The following are the most important Musci:

Cnestrum schisti
Dicranum groenlandicum
Funaria muehlenbergii?[1]
Hylocomium splendens
Polytrichum strictum
Rhacomitrium lanuginosum

Lichens are often much in evidence, especially light-coloured species, which may cover much of the surface (*See* Plate XXVIII), and which include *Cetraria nivalis* whose presence indicates the poorness of the snow-covering in many places. The lichen flora is much like that given above (pp. 86-7) as occurring chiefly on the tops of hummocks in the damp tundra, which suggests that the latter may perhaps in time develop into this drier, heathy type; however this may be, the following additional species were noted on a small area of this dry heath:

Alectoria nigricans[2]
A. nitidula
A. ochroleuca
Cladonia uncialis
Cornicularia divergens[2]
Ochrolechia frigida[2]
Parmelia physodes
Peltigera sp.
Sphaerophorus globosus
Stereocaulon alpinum

On the most favoured and drained, south-facing banks the *Vaccinium* may show bushy growth up to 12 cm. high and sometimes dominate the area almost to the exclusion of other species, as was the case occasionally at Arctic Bay (*See* page 70). Indeed this "blueberry heath" was so similar in the two places, even as regards the less plentiful associated species, that it would be superfluous to give here an account of examples from Pond Inlet, which, moreover, are intermediate in luxuriance between those of Dundas Harbour (*See* pp. 45-6) and Pangnirtung (*See* below). It should, however, be noted that the characteristic associates at Pond Inlet include *Ledum palustre* var. *decumbens, Empetrum nigrum* var. *hermaphroditum,* and *Antennaria angustata,* none of which is known to occur around Dundas or Arctic Bay.

(iii) MARSHES

A marshy type of mixed tundra having been described in detail above (cf. Plate XXVI), and the true marshes at Pond Inlet being very closely comparable in type and composition with those already considered from Arctic Bay, it seems unnecessary to say much more here. The chief dominants are again *Carex aquatilis* var. *stans, C. membranacea, Eriophorum angustifolium,* and *Arctagrostis latifolia,* although other grasses or species of *Eriophorum* or *Carex,* especially *Eriophorum spissum* and *Carex bipartita,* may be quite important locally. Growth is again most luxuriant around the margins of lakes, where one or more of the dominants, which here may exceed 40 cm. in height, is often so strong as to oust almost all possible competitors (*See* below).

[1] I have taken the liberty of querying this earlier determination in view of what has been remarked about it by Professor Steere (*See* Part II, p. 415).

[2] This report was inadvertently omitted from Part II.

(iv) SNOW EFFECT

The communities developed under the influence of deeply drifting and late-lying snow, although less frequently met with at Pond Inlet, owing probably to the lack of drastic physiographic change, are again very similar in type to those described above from Arctic Bay. Thus the outer, *Cassiope*-rich zones are frequently almost identical in composition with the example listed on page 73, whereas the non-heathy, generally herbaceous zones lying inside are much like the similarly situated ones at Arctic Bay. Especially prevalent at Pond Inlet were *Alopecurus alpinus* and *Oxyria digyna,* although almost all of the species listed on pages 75-6 from a late-snow area at Arctic Bay are also to be seen in such habitats at Pond Inlet, where the most notable addition is *Ranunculus pygmaeus.* This is one of the most characteristic of late-snow plants almost everywhere to the south, and already at Pond Inlet appears to be confined to such areas (cf. Polunin MS.g). It may be noted that the pH toward the centre of the chief snow-patch investigated was 6·8, and that although the surface was dark brown there was little humus below.

(v) SPECIAL LOCALIZED HABITATS AND COMMUNITIES

A peculiar habitat noted at Pond Inlet in 1934 was the bed of a lake that, as the result of a minor landslide, had suddenly lost most of its water early in the summer of 1932. The bed was of gravel or deposited humus with "polygons" of mud, and although devoid of macroscopic plants over some tracts many metres in extent, supported in others the following colonists. These are mostly "open soil" species[1] of good seeding capacity, although in 1934 few had here attained to flowering (or spore production in the case of the moss) in the two years that had elapsed since the surface had become available for colonization by land plants. All grew in sparsely open formation, and those marked with an asterisk occurred only as small seedlings:

Phippsia (Catabrosa) algida	f
**Luzula nivalis*	o
Arctagrostis latifolia f.	o
**Braya purpurascens*	
**Cardamine pratensis* var. *angustifolia*	
Cerastium alpinum	
Draba nivalis	
Eutrema edwardsii	
Luzula confusa	
**Oxyria digyna*	
**Papaver radicatum*	
Poa arctica	
Polytrichum hyperboreum	
Saxifraga cernua	
S. nivalis	
**S. oppositifolia*	
S. stellaris var. *comosa*	
**Senecio congestus*[2]	

The *Arctagrostis,* particularly, had become so changed, presumably in relation to local habitat conditions, that it was practically unrecognizable (*See* Part I of the present series, pp. 47-48). In the autumn of 1936 I revisited the spot and noted that mosses, whose almost entire absence in 1934 had much

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[1] Cf. Polunin (1939a, pp. 352 *et seq.*). Several of them occur in such situations in the British Isles (*See* Polunin 1939b, pp. 371-4).

[2] *Senecio congestus* (R. Br.) DC., Prodr. VI, p. 363, 1837 (*S. palustris* (L.) Hook. var. *congestus* (R. Br.) Hook.—*See* Fernald in Rhodora, XLVII, p. 256, 1945).

surprised me, were now frequent, although almost invariably remaining in the vegetative condition. Phanerogamic colonists had multiplied at least tenfold as regards the number of individuals, being now altogether very abundant in most places and in some just covering the surface. Every one of the species mentioned above had flowered and, in addition, *Chrysosplenium alternifolium* var. *tetrandrum, Draba glabella, Festuca baffinensis, Juncus biglumis, Lychnis apetala, Saxifraga hieracifolia,* and *Stellaria longipes.* I am not certain that all these were absent from the area in 1934 but I think they were; in any case colonization and development had been remarkably rapid, even compared with what might be expected on most areas around. For the bared surface was sheltered, humous, and frequently manured by visiting wildfowl, and must thus be admitted to be peculiarly favourable for colonization. Growth of the individual plants, in the absence of strong competition still in 1936, was unusually luxuriant in many cases, and the local Anglican Missionary had managed to grow good radishes and fair but small lettuces under glass on soil transferred from this area. Both these crops could also be grown in the open, but here failed to reach a usable size, although appearing to be more resistant to frosts than the native *Senecio congestus* (*S. palustris* var. *congestus*) and its f. *polycricos.*[1]

Other "peculiar" areas noted at Pond Inlet need to be considered only briefly. Thus some ruined stone and earth dwellings near the shore in one place were remarkable for the plentiful *Matricaria inodora* var. *nana* that grew on them, flowering profusely. Here *Alopecurus alpinus* attained a height of 50 cm. Again, in Plate XXV is illustrated a phenomenon of not infrequent occurrence near the coast—a dense grassy sward developed around a projecting boulder that is conspicuous and used as a perch by birds of prey and scavengers, and, accordingly, comes to be much visited by foxes, etc. The area around is usually almost barren, for it is only on exposed ridges and hills that these recognized landmarks occur; but as a result of manuring (and perhaps of the bringing in of disseminules) the community is surprisingly luxuriant, even if it is limited to a few square decimetres around the boulder. This latter is typically invested with orange nitrophilous lichens, the chief plant around being almost always *Hierochloe alpina,* as I have also seen in Spitsbergen and various other arctic lands. The chief associates in the example photographed were *Luzula confusa, Saxifraga tricuspidata,* and *Stellaria longipes,* while the green Alga *Prasiola crispa*[2] carpeted the ground in the lee of the boulder.

Other irregular tufts of grass, in one case dominated by *Poa pratensis* s.l. and including *Saxifraga rivularis* and *Chrysosplenium alternifolium* var. *tetrandrum,* are to be seen around the burrows of animals, or around decomposed carcasses. Also indicating the profound influence of nitrogenous increase are the communities developed in the present-day settlement at Pond Inlet. These show a considerable range of variation in spite of the small area and general grassiness, the local dominants or significant associates including most of the usual marshy tundra types and also *Alopecurus alpinus* (lvad), *Chrysosplenium alternifolium* var. *tetrandrum, Cochlearia officinalis* vars., *Matricaria inodora* var. *nana, Phippsia* (*Catabrosa*) *algida* (la), *Poa pratensis* (ld), *Saxifraga cernua, S. rivularis,* and *Stellaria longipes* (la).[3] The first blossoms to appear are generally those of *Saxifraga oppositifolia* early in June; by the end of the

[1] *Senecio congestus* (R. Br.) DC. f. **polycricos** (Polunin) *n. comb.* (*S. palustris* (L.) Hook. f. *polycricos* Polunin, Bot. Can. E. Arctic, I, p. 367, 1940).

[2] This report, from my field notes, I unfortunately did not transmit to Dr. Whelden in time for inclusion in Part II of the present series.

[3] The following Algae were collected on a frozen patch of soil in the settlement early in September, 1936: *Prasiola crispa* d; *Cosmarium undulatum; Microspora stagnorum; Penium truncatum; Staurastrum mucronatum; S. proboscidium; S. punctulatum.*

month a considerable range of other types are to be found in flower, including Drabae, *Dryas*, Salices, and often *Pedicularis lanata*. This is the usual sequence almost throughout the Canadian Eastern Arctic, as may be confirmed by a perusal of the diary of almost any traveller therein.

(vi) FRESHWATER

The various communities associated with streams and lakes around Pond Inlet are in general similar to those described above from Arctic Bay, which lies within the same "major district" of our area. However, three of the lists of Algae collected at Pond Inlet early in September, 1936, seem worth giving for purposes of comparison with those taken a week later at Arctic Bay, which lies about 150 miles (241 km.) away to the west. In both places the surface of the water was generally frozen. It should be noted that only the first of these three lists includes the freshwater Diatomeae that were present.

(1) In a rapidly flowing streamlet:

Achnanthes minutissima var. *cryptocephala*
Aphanochaete repens on filaments of *Oedogonium* sp.
Caloneis silicula var. *alpina*
Calothrix borealis
Cyclotella antiqua
Cymbella botellus
C. turgida
Denticula tenuis var. *intermedia*
Diatomella balfouriana
Dinobryon sertularia
Euastrum binale var. *sectum*
Eunotia curvata
E. fallax var. *typica*
E. glacialis
E. pectinalis var. *minor* and var. *stricta*
E. praerupta var. *genuina*
E. tenella
Fragilaria pinnata
Geminella interrupta
Gomphonema angustatum var. *aequale*
Lyngbya rigidula in groups on filaments of *Oedogonium* sp.
Meridion circulare
Microspora willeana
Navicula avenacea
N. cryptocephala
N. ramosissima
N. vulpina
Nitzschia amphibia
N. frustulum
N. palea
Oedogonium sp.
Oocystis borgei
Peridinium cinctum
Pinnularia divergens var. *genuina*
P. leptosoma var. *undulata*
P. spitsbergensis
Staurastrum pachyrhynchum
Stauroneis phoenicenteron var. *amphilepta*
Stigonema ocellatum
Synedra amphicephala
S. ulna var. *genuina*

(2) In eddy in sluggish, peaty brook:

Aphanocapsa grevillea
Chroococcus minutus
Closterium cornu

C. decorum
C. moniliferum
Cosmarium arctoum
C. curtum
C. subcrenatum
Gloeothece confluens
Hyalotheca dissiliens
Oocystis elliptica
Rivularia dura
Schizothrix calcicola
Staurastrum pachyrhynchum
S. proboscidium
S. punctulatum
Stigonema turfaceum

(3) On bed of a tiny pool:

Closterium abruptum
C. macilentum
C. parvulum
C. ralfsii var. *hybridum*
Cosmarium speciosum
C. subcrenatum
Desmidium swartzii
Dinobryon marchicum
D. sertularia
Gloeothece rupestris var. *maxima*
Gonatozygon monotaenium
Microcystis robusta
Microspora stagnorum
Nostoc sp.
Staurastrum forficulatum var. *longicornis*

A notable feature of many lakes in exposed situations is the difference in appearance of the sides according to their orientation with regard to the prevailing winds. The latter come from the coast, especially from the north-west, and, acordingly, the side of the lake to windward, where there is some slight shelter from the ground behind, may support beds of Carices and Eriophora growing out into the water (as is seen in Plate XXIX), where *Eriophorum chamissonis* f. *albidum* and such mosses as *Drepanocladus brevifolius* and *Scorpidium scorpioides* may be plentiful. On the other hand the "leeward" side (Plate XXX) is somewhat paradoxically exposed to the full blast of the wind and, unless the body of water be a mere small pool, is apt to be so frequently and forcibly washed by quick little waves that a scoured "hard line" or banked-up rampart of matted roots and rhizomes forms its margin. Colonization of open water by the dominants of the marginal sward, such as *Carex aquatilis* var. *stans,* is here limited to sheltered bays or the lee of islets, as is seen in Plate XXX.

(vii) STRAND AND MARINE

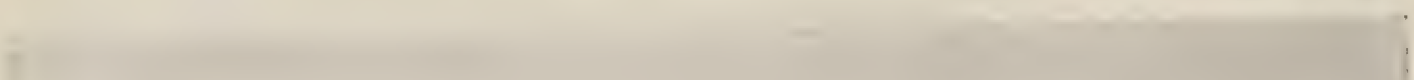
The seashores where damp and sandy or muddy are colonized in many places by *Puccinellia phryganodes,* to be followed by a community dominated by it in the manner seen almost everywhere else, except for the substitution at Pond Inlet of *Puccinellia paupercula* and *Carex bipartita* var. *amphigena* for the usual associates (*Carex ursina* and *Stellaria humifusa*).

On dry sands the community above high tide-mark is quite different, though again highly characteristic, the surface being often colonized by the well known sand-binding "Lyme grass" *Elymus arenarius* (here all var. *villosissimus*), which in all the world has its northernmost known station at Pond Inlet. As on so many coasts almost throughout the northern hemisphere, the

PLATE XXIX

Lake in exposed situation near coast. Prevailing winds are from the right, this side being, accordingly, sheltered and well vegetated, with beds of sedges growing out into the water. Faintly in the distance are seen the mountains and glaciers of Bylot Island. Pond Inlet, N. Baffin, Sept. 12, 1934.

PLATE XXX



The wave-washed "leeward" margin of the lake shown in Plate XXIX, where colonization of open water is prevented except in sheltered bays and the lee of islets. Thus, *Carex aquatilis* var. *stans* can be seen pioneering in the water to the left of the islet in the centre. Pond Inlet, N. Baffin, Sept. 12, 1934.

sand is bound by the *Elymus* and may even form miniature dunes (*See* Plate XXXI), of which the largest I have seen at Pond Inlet were about a metre high and exceeded by the *Elymus* by no more than 20 cm. Also binding the sand in places are flat rosettes of *Mertensia maritima* var. *tenella* and domed tussocks of *Arenaria peploides* agg. (seen in the foreground of Plate XXXI). Other predominantly or exclusively shore plants noted at Pond Inlet include *Carex maritima, Cochlearia officinalis* var. *groenlandica, Puccinellia angustata, Stellaria longipes* f. *humilis* (also on exposed ridges inland), and *Stellaria humifusa.*

PLATE XXXI

Miniature dunes formed by ***Elymus arenarius*** var. ***villosissimus*** on sandy seashore. In the foreground are domed patches of ***Arenaria peploides*** agg., and in the distance are seen faintly some snow-covered mountains and glaciers on Bylot Island. Pond Inlet, N. Baffin, Sept. 12, 1934.

The tidal range is locally very small (5-6 feet?) and the gravelly foreshore is largely barren, although some small Fuci may occur, and the usual *Pylaiella littoralis.*[1] Below the region most disturbed by tides and ice, life is far more abundant, and communities dominated by much larger Algae occur. These communities have not been investigated and so their composition can only be guessed at; the following Algae, which are the ones most frequently washed up in a fresh condition on the shore, are probably all of importance in this formation:

Agarum turneri
Ahnfeltia plicata
Alaria esculenta
Delesseria sinuosa
Fucus vesiculosus
Laminaria saccharina

[1] The report of this species from Pond Inlet was inadvertently omitted from Part II, p. 115.

(4) CENTRAL BAFFIN

This district is delimited on the north by a line drawn in a southwesterly direction from just north of Cape Adair to the west coast, and on the south by a line drawn from the point of intersection of the Arctic Circle and the west coast to Neptune Bay (c. 64° 30′ N.) on the east coast. It comprises probably rather more than one-third of the 201,600-odd square miles of Baffin and extends from about 71° 30′ N. southwards to 64° 30′ N., and from 61° 10′ W. to about 79° 20′ W., which last is the probable longitude of the westernmost extremity of the Spicer Archipelago and adjacent larger islands to their north that seem best considered as belonging to Central Baffin.

Although fairly broad outwash plains are not entirely lacking, the east coast, which includes almost all of the better-known points in this district, is in most places mountainous and very rugged. The mountain ranges are frequently ice-bound and the shores rocky and precipitous, and repeatedly indented by long fiords or broader inlets; the largest of these is Cumberland Sound, which is about 140 miles (225 km.) long and 40 miles wide, and, like most of the coast to the north, beset by numerous islands. Inland, to the west, the tall peaked mountains (cf. Wordie 1935, especially photo facing p. 308, and Millward 1930, p. 46) give way to lower, rounded hills (Weeks 1928, p. 89c) and in time to low rolling country with many lakes and rivers, including some of considerable size (cf. Millward 1930, frontispiece, etc.). Finally, toward the little-known west coast, the country is in many places almost entirely flat, although in others still hilly or (probably in contrast) almost mountainous (Rosenmüller 1913, pp. 708 *et seq.*, and cf. M. B. A. Anderson 1930, pp. 121-6). The northern parts of this coast have latterly been explored by Graham Rowley and the late Reynold Bray, and further by P. D. Baird and the indefatigable T. H. Manning, who report large islands and low, rounded hills; the vegetation, at least in places and as far as could be seen in winter, is closely comparable with that of Pond Inlet described above.

Of the southern 'great plain' Manning (MS.) reports, "Inland the long, waving grass which is predominantly brown in the summer, might, from the distance, be a summer hayfield, but closer inspection shows that the long stalks are widely scattered except in some marshy areas." The whole appears to be underlain by the same horizontally stratified Ordovician limestone. During a reconnaissance flight in August 1946 I observed that the Spicer and adjacent islands of Foxe Basin are also of limestone and quite low (MS.o).

GEOLOGY

A broad outline of the geological features of this central part of Baffin can again be given in a few words, compiled from many sources. Most of the area, at least as far as it has been explored, is composed of Archæan (supposedly Precambrian) granites and gneisses of the types frequently found to the north. Thus almost the whole of the east coast of this sector, including Cumberland Sound, is so occupied, although a small area of poorly consolidated and supposedly Tertiary rock is found a little to the south of the 70th parallel around the head of Isabella Bay.

The other primary change is to a surface of limestone, largely if not entirely of Ordovician age, in the west and southwest, whence it extends eastward at least to the western shore of Nettilling Lake and northward for a distance that does not appear to have been fully determined (*See* Bethune 1935, map at end, but cf. Soper 1930, p. 4, M. B. A. Anderson 1930, pp. 126-7, and Manning

MS.). The observations of the last named indicate that limestone is found on the west coast and its adjacent islands practically throughout the length of Foxe Basin. In Cumberland Sound, the best known region of all, the rocks are all acid intrusions, although some variation in texture and composition occurs (cf. Weeks 1928, p. 92c). Most common is a rather coarse-grained, greyish granite, and most notable among complications is the frequent occurrence, if only locally, of such minerals as orthoclase, plagioclase, and quartzite—also the presence of considerable deposits of graphite on Blacklead Island.

CLIMATE

Whereas the climate of Pond Inlet post and probably many other parts of northern Baffin was only slightly, if at all, more favourable than that of Dundas Harbour farther north (so that the more luxuriant vegetation at Pond Inlet could only doubtfully be referred to climatic causes), the climate at Pangnirtung, which is probably representative of the more favoured regions of central Baffin, is distinctly better than at Pond Inlet. This is immediately seen on comparing the Pangnirtung "weather" details given below with similar data from Pond Inlet (*See* pp. 61-2). Thus at Pond Inlet there are generally only 3 months having a mean temperature appreciably above freezing point, and their values over a period of years are 34, 42, and 41° F.; at Pangnirtung there are 4 such months, the values over a similar period being 38, 46, 45, and 37° F. September is the addition; and it is most significant here, too, that July and August generally

Temperatures at Pangnirtung, 66° 6′ N., 65° 30′ W. Average 1931-4.

Month	Temperature °F.			Precipitation	
	Maximum	Minimum	Monthly mean	Total inches	Snow or rain
January	21·5	−38	−18	0·74	S
February	26	−39·5	−15	0·74	S
March	25	−37	− 9	0·51	S
April	38	−27	6	1·07	S
May	46	3	27	0·43	S (trace R)
June	53	26	38	0·75	S and R
[1]July	64	33	46	1·03	R
[2]August	63	33	45	2·21	R
September	53	2	37	1·2	S and R
October	45·5	6	25·5	2·11	S and R
November	40	−14	10·5	0·65	S
December	26	−35	−10	0·81	S

[1]Average of 3 years only.
[2]Average of 2 years only.

pass without frost unless it be of the local "ground" type. This amelioration and prolongation of the growing-season is of the greatest importance to plant growth and the resultant vegetation. Moreover, the precipitation is much heavier than at Pond Inlet and elsewhere to the north, averaging at Pangnirtung a total of over 12 inches (30·5 cm.) per annum in the period 1931-4, and including much rain during the 4 summer months June to September, and often a little in May and October.

To what extent Pangnirtung, which is the only place for which I have been able to obtain reliable data covering a period of years, is typical of other parts of central Baffin I have not the knowledge to say.[1] However, it does seem to be

[1] Since this was written more observations have been made which tend to confirm the situation as here outlined; moreover, with the current and planned meteorological stations our knowledge of the climate of Baffin and surrounding areas should increase greatly during the next few years. (May 1947.)

considerably affected by its sheltered "fiord-side" position, although the climate is scarcely more continental in type than the poor one of Pond Inlet. A perusal of the "Monthly Record of Meteorological Observations" (Ottawa: Department of Marine) suggests that, even if the data are deficient, Clyde (*See* below) has a considerably cooler summer and colder winter, although it is much nearer the outer coast. The exposed western plains appear also to have a less favourable summer than Pangnirtung (cf. Soper 1930, pp. 35-7), and a colder winter (cf. Rosenmüller 1913); but on the other hand, the summer of the interior, at least around Nettilling Lake (c. 66° 30′ N.; c. 71° W.), appears to be considerably warmer even than that of Pangnirtung (cf. Soper 1930, p. 35).

VEGETATION

In view of the detailed surveys of the vegetation given below from two widely separated places in this major district, and of the probability that these surveys include descriptions of a fair proportion of the main plant communities therein, it seems unnecessary here to quote in full the rather numerous remarks on the vegetation, which have been made more or less casually by unqualified observers, and which are often only comparative and quite unreliable. There have, however, recently been some more useful ones made by scientists or visitors to little-known corners of the area.

Thus, starting as usual in the north and working south and west, we may note that the headwaters of Mr. Wordie's "Dexterity Fjord" lie within the present district. The vegetation is here said to be "rather poor" (cf. also Wordie 1938, photo facing p. 399), although in bays farther down the fiord it is often quite luxuriant.[1] The country to the southeast appears rather similar, with the vegetation very poor in some places (cf. Wordie 1935, photo facing p. 306) but rather luxuriant where conditions are suitable (*ibid.*, photo facing p. 302). The same slopes are often blotched with "whiter patches on the darker general background. These turned out to be due to the prevalence at certain spots of long continuing snow drifts, which melted so late in the summer as to give no chance for the beginning of lichen growth" (*ibid.*, p. 310). The vegetation of such "late-snow patches" will be described in detail below, in an account of the vegetation of Clyde, which lies near the exposed coast in this region.

Of Exeter Sound (c. 66° 20′ N.; c. 62° W.) Goodsir writes (1850, p. 133) "On the south side the shores were abruptly precipitous, as were they also on the north side, until about three miles from the entrance, but then, they formed a beautiful slope—now glowing in the evening sun, in the brightest red, brown, and yellow, with here and there patches of green, like one of our own moors. But the delicious perfume that came off from this shore—'the smell of land'—of the here somewhat plentiful vegetation drying under the autumn sun, was perfectly delightful".

No other worthwhile information is forthcoming on the vegetation of the east coast, apart from Clyde (*See* below), but from Cumberland Sound we have much. The outstanding plant communities occurring around Pangnirtung are described in full below; the vegetation, though in general similar, may be even more luxuriant very locally in some sheltered valleys in bays around the head of Cumberland Sound (Soper 1928, p. 5, and cf. Gray, 1879, p. 163).[2] Farther

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[1] The coast to the east of this region was long ago visited by Parry (1821, p. 273), who remarked of a point in lat. 71° 15′ N. that "The vegetation was tolerably luxuriant in some places upon the low land which borders the sea, consisting principally of the dwarf-willow, sorrel, saxifrage *(Saxifraga Cernua)*, and poppy, with a few roots of scurvy-grass."

[2] Although in some places it is still "extremely scanty"—e.g., around Annanactook Harbour (cf. Kumlien 1879, p. 70).

west, in the interior around Nettilling Lake, the vegetation appears again to be similar to that of the lowlands at Pangnirtung; at least, the dominants are the same and so is most of the flora (*See* M. B. A. Anderson 1930, p. 118, and Soper 1928, pp. 15-16, and cf. Part I of the present series), although probably on the whole it is rather poorer, the country being for the most part flat and exposed (Soper 1930a, pp. 440-442).

From the western parts of the Nettilling Lake district there extend low plains, which are in places nearly 100 miles wide, right to the west coast. They are of "tundra country, abundantly covered with grassy growth and, in places, moss, while lichens are lacking" (M. B. A. Anderson 1930, p. 122), or, again (p. 123), "The tundra is rich with grass, in places with moss also, but showing no lichens; also often willow shrubs grow to a fair height, one meter long, but seldom rising above the ground more than 25 cm." More reliable than these investigations by the naïve Dresden schoolmaster Hantzsch, who shortly afterwards perished on this inhospitable west coast, are the observations made later by Soper, from which it is clear that sedges are the chief dominants over most areas of these rather swampy plains (cf. Soper 1930, pp. 30-32), which extend "north to latitude 67° 17′, with an area of about 5,500 square miles" *(ibid.,* p. 21). Soper (1928, p. 132) gives a photograph of these plains, although in a disturbed, riverside area where the vegetation is by no means closed. More typical, probably, are Soper's photographs (1930, pp. 36, 50) taken in the same plains but farther to the south, at Camp Kungovik[1] in southern Baffin, which show closed marshy vegetation that is indeed grassy in appearance.[2]

The Spicer Islands, which during a reconnaissance flight in August 1946 we finally confirmed as lying near the centre of Foxe Basin around 68° 10′ N. and 79° W., are continued to the north by larger islands that appear to form a chain extending to the southern shore of northwest Baffin. All of these islands that lie well out in Foxe Basin appear to be of limestone and flat and low, as already described in more detail and illustrated elsewhere (Polunin MS.o). The southernmost sizeable unit of the Spicer Archipelago and adjacent islands appeared from the air to have about a quarter of its surface occupied by shallow lakes and tarns. Brown, apparently marshy, vegetation occupied about half of the total area, and the remaining one-quarter bore streaks and humps of light grey limestone that in places looked yellowish in the sun. The sides of banks were often a more vivid yellow with, probably, *Cetraria nivalis*—which contrasted markedly with their grey tops and the brown, vegetated depressions. The coasts were low and shelving, light brown and dotted with stranded ice-pups when the tide was out. Above high tide-mark, the rocks were in places conspicuously orange coloured near the water—presumably by lichens such as *Caloplaca* spp. where manured by birds; below low tide-mark there appeared to be beds of dark brown Algae. The next sizeable island to the north looked similar as regards conditions and attendant vegetation, but more swampy and irregular in outline. Smaller adjacent islands likewise give the impression of being tolerably well vegetated. To the north of the Spicers, but still so well out in Foxe Basin as to have been missed by all earlier explorers, lay another, much larger island that also appeared to be of grey limestone, and, from a distance, looked drier and more barren.

Of the hilly area to the north of these plains, and northwest of Nettilling Lake, Manning writes (MS.) that "The surface . . . is composed of disintegrated limestone, chiefly in the form of gravel. Between the ridges, which are almost

[1] This place was unfortunately included in central Baffin in Part I of the present series, but lies just south of the boundary.
[2] Cf. the quotation given above (p. 96) from Manning MS.

bare of vegetation, there are some areas of semi-marsh and grassland, though I doubt if these occupy more than half the total area." Of the coast to the west the same recent observer writes (MS.) that it "consists of low hills of crystalline rocks, chiefly red granite, rarely exceeding 60 feet in height. Inland, the ridges are interspersed with grassland, but this reaches the shore in only two places south of Hantzsch river."

Plant Communities Around Clyde "River"

The area investigated here was a limited one, extending no more than 2 miles from the Hudson's Bay Company's trading post, which is situated in latitude 70° 27′ N., longitude 68° 35′ W., toward the head of a deep cove (*See* local map given by Wordie, 1935). The country there is undulating and comparatively low, belonging to the coastal plains region and being interrupted by numerous lakes, whereas in the distance, both inland and to the south, there are to be seen quite high mountains.

The fundamental rocks of this district are reddish gneisses, but most of the area investigated is covered by morainic material that has been rewashed by the sea. Over most areas these deposits contain little or no calcareous material; indeed, the soils wherever tested were acidic in reaction and failed completely to effervesce with HCl. The deposits frequently form low terraced ridges, which look very fresh, appearing to have been left bare and open to colonization by plants only in relatively recent times (perhaps only a very few hundred years ago, or less in some instances)[1], owing either to recent ice recession or to recent uplift. The latter seems the more likely supposition, as signs of Eskimo encampments belonging to earlier cultures than that of the present day, and which are normally limited to the immediate seashore, are to be found far above the present level of the water. Even the local "subfossil" marine shells look more recent than in most other places, frequently having their outer chitinous covering still present, according to verbal information from Mr. D. A. Nichols (lately of the Geological Survey of Canada). The appearance of the vegetation does not merely bear out, but of itself forcibly suggests, such recent emergence of much of the area, for the communities are poor and the soil very thin in most places; moreover, above 100 feet (30·5 m.) on some of the hills the vegetation appears to be more advanced, and humous deposition more appreciable. Yet even here no bushy willow or other growth comparable with that seen at Pond Inlet was encountered; indeed the tallest plants appeared to be occasional grasses (especially *Hierochloe alpina*), which just exceeded 40 cm. in height. The flora, too, is surprisingly small.

The range of habitats and significantly different plant communities that were noted in the limited area investigated was rather small, as the following account will show; probably a much larger flora and variable vegetation occur in the mountainous areas, especially away from the seacoast.

(i) HILL SUMMITS

The summits of small hills were found to have a surface usually of glacier-worked material, including finely comminuted "soil" and projecting, more or less rounded boulders (*See* Plate XXXII). The boulders supported numerous crustaceous and foliose lichens, whose growth was noticeably more luxuriant on

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[1] There can be absolutely no doubt that colonization of unsuitable surfaces, at least in exposed situations, is immeasurably slower than on such favoured areas as the lake bed described at Pond Inlet, which was mentioned chiefly to show how very quickly such colonization can take place even in the Far North, given the best conditions. Thus many areas remain largely barren even after hundreds and probably thousands of years.

PLATE XXXII

Looking seawards over the lake-bound coastal plains. Hill summit in foreground is of glacier-worked material vegetated chiefly by lichens. A few vascular plants are to be seen toward the bottom left-hand corner. Clyde, C. Baffin, Sept. 9, 1934.

PLATE XXXIII

Rocks near hill summit. They are largely covered with lichens, whose growth is much more luxuriant on the north-facing (right-hand) surfaces than on those facing south. Clyde, C. Baffin, Sept. 9, 1934.

the north-facing than the south-facing side, presumably owing to the more rapid drying out of the latter surfaces by the sun. This is well seen in Plate XXXIII, taken on a slope slightly below a summit, where the rocks were more rugged and growth was considerably more luxuriant than on the summit itself, the Gyrophorae including some specimens as much as 8 cm. in diameter.

On the rounded summits, the surface gravels supported lichens of fair growth and sometimes mosses, but very few angiosperms. However, tufts of *Luzula confusa* and *Hierochloe alpina* were far from rare, and occasional sheltered depressions supported patches of higher vegetation consisting of these two species and also *Luzula nivalis, Poa arctica,* and *Salix arctica,* or, even more locally and rarely, of *Dryas, Cassiope tetragona,* and *Vaccinium uliginosum* var. *alpinum. Potentilla hyparctica* (*P. emarginata* var. *typica*) and *Salix herbacea* were also found on one summit, where the tufts of vegetation were bound by *Rhacomitrium lanuginosum* and the peculiar liverwort *Chandonanthus setiformis.*

The following were the chief bryophytes and macrolichens found growing in one place near the summit of a hill among large jagged rocks—chiefly in sheltered crannies where they frequently formed quite luxuriant mats, though of limited extent:

Musci	*Polytrichum alpinum*
	Rhacomitrium lanuginosum
	Trichostomum sp.?
Hepaticae	*Chandonanthus setiformis*
	Gymnomitrium corallioides
	Scapania aspera
Lichenes	*Alectoria orchroleuca*
	Cetraria crispa
	C. nigricans
	C. nivalis
	Cladonia bellidiflora
	C. coccifera var. *stemmatina*
	C. cornuta
	C. elongata
	C. lepidota
	C. mitis
	C. uncialis
	Dactylina arctica
	D. ramulosa
	Gyrophora cylindrica var. *delisei*
	G. torrefacta[1]
	Ochrolechia frigida
	Parmelia omphalodes
	Pertusaria dactylina
	P. oculata
	Sphaerophorus fragilis
	S. globosus
	Stereocaulon denudatum
	Thamnolia vermicularis

(ii) PLAINS

The gravelly plains low down near the sea, although looking brown from a distance, are in many places only very poorly vegetated, owing probably to their having risen from the sea only in comparatively recent times (*See* above). The dark colour is due chiefly to lichens, higher plants being very few and often limited to cracks separating irregular polygonal areas 10-30 m. in diameter.

[1] Not recorded from this place in Part II.

These cracks generally support a continuous "line" of *Luzula confusa* or *Hierochloe alpina*, bound by *Rhacomitrium lanuginosum* and various other coarse cryptogams—especially *Dicranum elongatum, Polytrichum alpinum,* and *P. piliferum* among the mosses, and *Cetraria nivalis, Cladonia elongata, C. mitis,* and *C. uncialis* among the lichens. Only in larger depressions were other phanerogams to be found at all frequently, and then only the few species mentioned from hilltops. Quite surprising was the usual absence of *Saxifraga oppositifolia.* The "polygons" themselves, although their gravelly surface looked quite stable, generally supported only *Polytrichum alpinum* and small lichens, of which the following were most conspicuous over one area:

Buellia atrata
Gyrophora hyperborea
G. proboscidea[1]
Lecanora polytropa var. *illusoria*
Parmelia alpicola
P. incurva
P. pubescens
Rhizocarpon chionophilum
R. geographicum

In other such open gravelly or sandy places, especially near the shore, the flora tends to be less extremely reduced, and the phanerogamic vegetation less limited, although not often closed. Most frequently, "barrens" of grassy appear-

PLATE XXXIV

Half-closed, better type of "young" area near sea-level, interrupted by erratic boulders (several low ones are barely discernible in the foreground). Clyde, C. Baffin, Sept. 9, 1934.

ance characterized by Luzulae are produced, in which the vascular plants look continuous from a distance but actually cover only about half the area, being dispersed among open or lichen-covered patches of gravel, and furthermore often disturbed by erratic boulders in the manner shown in Plate XXXIV. That the

[1] Not recorded from this place in Part II.

area is "young", having probably risen from the sea only in relatively recent times, is further evidenced by the fact that, apart from a thin black crust which accumulates in places on the surface, there is practically no humous deposition, although the reaction is slightly on the acid side of neutrality (pH 6·2).

A 4-metre quadrat gave the following list:

SPERMATOPHYTA	*Luzula nivalis*	a
	L. confusa	f-a
	Alopecurus alpinus	f
	Arenaria rubella	f
	Oxyria digyna	f
	Draba alpina var. *gracilescens*	o
	Juncus biglumis	o
	Papaver radicatum	o
	Poa arctica	o
	Ranunculus sulphureus	o
	Saxifraga nivalis incl. apprg. var. *tenuis*	o
	S. stellaris var. *comosa*	o
	Stellaria longipes apprg. f. *humilis*	o
	Cerastium alpinum	r-o
	Salix arctica	r
	Saxifraga caespitosa	r
	S. cernua	r

The following were more casual colonists, or relics of previous colonization, noted on a larger area where the chief plants exerted even less control:

Arctagrostis latifolia
Cochlearia officinalis var. *groenlandica*
Draba alpina var. *nana*
D. fladnizensis
D. glabella?
Festuca brachyphylla
Lychnis apetala
Phippsia (Catabrosa) algida
Potentilla hyparctica (P. emarginata var. *typica)*
Sagina intermedia
Saxifraga oppositifolia
S. rivularis

The chief cryptogams were:

MUSCI	*Rhacomitrium lanuginosum*	a
	Drepanocladus uncinatus	
	Kiaeria blyttii	
	Tortella tortuosa	
LICHENES	*Cetraria delisei*	va
	Alectoria nigricans	f
	Cetraria crispa	f?
	Cladonia mitis	
	C. uncialis	
	Dactylina ramulosa	
	Pertusaria coriacea	
	Sphaerophorus globosus	
	Stereocaulon alpinum	
	S. denudatum	
	Thamnolia vermicularis	

Most of the drier areas on the plains and gentle lower slopes of the hills are occupied by some such "barrens" in sandy or gravelly places, and by little more than cryptogams where the surface is of boulders or broken rock. In contrast with the growth of lichens in some circumstances, phanerogamic vegetation is noticeably poorer on most north- and east- (toward the sea) facing slopes than on those having a southerly or westerly aspect, at least when other habitat

conditions are similar. On some of these south-facing slopes, when the incline is slight and water plentiful, what is probably the most luxuriant vegetation of the immediate vicinity tends to be developed—especially well above sea-level. The community may possibly represent the closest local approach to the regional climax, although it is probably still far from stabilized, being most reminiscent of the damp mixed tundra described from Pond Inlet. Thus the vegetation is closed and often quite luxuriant—*See* Plate XXXV and cf. Plate XXXVI, the latter being a "close-up" of the dense grassy sward around an erratic rock, up whose lichen-covered side the dark *Cassiope* is seen growing much higher than elsewhere.

The phanerogamic flora is in general much poorer than at Pond Inlet, and the surface is often smooth, due to the absence of hillocks where there is drainage. Nevertheless, the soil is retentive of water, being damp in summer except in lastingly dry weather, and projecting boulders tend to be moved so as to present fresh surfaces. This is probably a result of frost-heaving and is exemplified by the boulder in the foreground in Plate XXXV, which shows only a light-

PLATE XXXV

Luxuriant, damp mixed tundra on favourable slight slopes. Clyde, C. Baffin, Sept. 9, 1934.

coloured, smooth surface, uncolonized by lichens. The surface sward of mixed mosses, sedges, grasses, and heaths varies in composition considerably from place to place, and sometimes undulates over boulders. Wherever investigated it was found to be shallow, being underlain by a few centimetres of semi-liquid, humous material and then by light-coloured boulder clay that from a depth of 1-3 cm. below its surface was practically unstained by humus, although the reaction was

acidic (pH 5·6). This was the case even in the more or less flat areas where hummocks were developed, and where the following typical list of the more important species was made:

SPERMATOPHYTA	*Eriophorum angustifolium*	f-vad
	Carex aquatilis var. *stans*	f-a
	Cassiope tetragona	f-a
	Arctagrostis latifolia	f-la
	Carex misandra	o-la
	Luzula nivalis	f
	Poa arctica	f
	Polygonum viviparum	f
	Salix arctica	f
	S. herbacea	o-f
	Dupontia fisheri	o
	Juncus biglumis	o
	Luzula confusa	o
	Pedicularis hirsuta	o
	Alopecurus alpinus	r
	Draba fladnizensis	r
	Dryas integrifolia f. *intermedia*	r
	Potentilla hyparctica (P. emarginata var. *typica)*	r
	Saxifraga stellaris var. *comosa*	r
	Vaccinium uliginosum var. *alpinum*	r

PLATE XXXVI

Grassy sward and *Cassiope* around erratic boulder in damp mixed tundra. In the foreground, *Eriophorum angustifolium* is seen on the left and *Arctagrostis* in the centre; on the right lichens lighten the ground. The dark *Cassiope* grows unusually high in front of the boulder, which affords shelter, and which is well covered with lichens. Clyde, C. Baffin, Sept. 9, 1934.

Cryptogams were variable in species and numerous, forming a continuous investment with the higher plants. In this, three species of *Sphagnum* and two of *Aulacomnium* were much in evidence, sometimes between them covering half

the area and forming tussocks up to 30 cm. in height. It was most characteristically on these tussocks that the larger lichens grew, the Cladoniae here forming something of a "reindeer moss" sward in a manner not seen to the north. The most obvious or ecologically important cryptogams, excluding lithophytic or chasmophytic species on the erratic boulders, were as follows:

MUSCI	*Aulacomnium palustre*
	A. turgidum
	Calliergon sarmentosum
	Mnium undulatum?
	Polytrichum sp.
	Sphagnum fuscum
	S. capillaceum var. *tenellum*
	Sphagnum sp.[1]
	Tetraplodon mnioides
LICHENES	*Alectoria nigricans*
	A. ochroleuca
	Cetraria crispa
	Cladonia coccifera[2] and var. *stemmatina*
	C. elongata
	C. mitis
	C. rangiferina
	C. uncialis
	Dactylina arctica
	Ochrolechia frigida
	Parmelia omphalodes
	Peltigera scabrosa ? (sterile)
	Thamnolia vermicularis
FUNGUS	*Omphalia umbellifera*

(iii) MARSHES

In spite of the preponderance of low and almost flat areas, true marshes, as opposed to damp tundra including heath and "barrens" elements (*See* above), appeared to be of poor development and rather limited extent at Clyde. Thus Plate XXXVII shows a typical damp, lowland area with water standing in many places, and with the soft muddy surface vegetated by dense but irregular colonies of *Eriophorum scheuchzeri*, whereas much more of the area, although it appears equally suitable for colonization, is largely devoid of higher vegetation. Colonization appears to have been a matter largely of chance dispersal, and the whole terrain, including the jagged rocks strewn about, looks "young" in the absence of stabilization by vegetation and consequent deposition of humus.

On some areas, including such gentle slopes as that shown in Plate XXXVIII, which is dominated by *Eriophorum angustifolium*, these colonized marshy areas may be more extensive; but here again they rarely appear even to approach a state of equilibrium with the local habitat conditions, being generally much interrupted by bare patches of mud. Nor are they nearly as luxuriant, or in associated species as rich, as similar areas developed elsewhere in Baffin.

(iv) SNOW EFFECT

The zoned series of subclimaxes developed in relation to deeply drifting and late-lying snow are well seen in many places at Clyde, especially on north- and west-facing slopes where the snow lies longest. In the Far North the universal shortness of the growing-season allows the development (or, at least, the recognition) of only two or three zones; in the south there may be five or six, as for

[1]Unfortunately lost in transit and not determined but probably *S. girgensohnii*, which occurred nearby.
[2]Not separately recorded in Part II of the present series.

PLATE XXXVII

Irregular colonies of *Eriophorum scheuchzeri* in damp, muddy areas that are otherwise largely barren and look quite "young". Clyde, C. Baffin, Sept. 15, 1936.

PLATE XXXVIII

Extensive marshy slopes dominated by *Eriophorum angustifolium* of poor growth, with few associates. Looking westward towards inland mountains. Clyde, C. Baffin, Sept. 9, 1934.

example on Akpatok Island (Polunin 1934, pp. 385-9). In the present intermediate, central part of our area there are generally four (at most five) fairly well-marked zones in the larger snow-patches (*See* Plate XXXIX).

Zone I. In the outermost zone, whose snow affords a goodly protection in winter but does not melt so late that the already short growing-season is reduced by more than a very few weeks, and where the surface dries out rather quickly, *Cassiope tetragona* is the dominant as in most other districts. It may form an

PLATE XXXIX

Looking across a late-snow area from the *Cassiope* zone, where even the boulders are vegetated, to the centre where patches of snow still persist, surrounded by barren rocks and tracts of earth. Clyde, C. Baffin, Sept. 9, 1934.

almost closed heath but more typically covers only about half the area, being much interrupted by patches of cryptogams and other plants. Plate XXXIX was taken from the inside of such a zone, whose dark patches of *Cassiope* cover only about one-quarter of the area; it looks across to the centre of the patch where some snow still persists in autumn, surrounded by an innermost zone that is largely barren (the bare boulders show almost as white as the rather dirty snow). A small area taken at random about the centre of the *Cassiope* zone gave the following list; the dominant grew 5-8 cm. high and was much interrupted by patches of cryptogams in which grew the majority of the associates:

VASCULARES	*Cassiope tetragona*	vad
	Luzula nivalis	f-a
	Salix herbacea	f
	Carex bigelowii	o-f
	Poa arctica	r-f
	Luzula confusa	o
	Lycopodium selago	o
	Pedicularis hirsuta	o
	Polygonum viviparum	o
	Salix arctica	o

Vaccinium uliginosum var. *alpinum*	o
Hierochloe alpina	r-o
Oxyria digyna	r-o
Alopecurus alpinus	r
Carex misandra	r
Papaver radicatum	r
Potentilla hyparctica (*P. emarginata* var. *typica)*	r
Sagina intermedia	r
Saxifraga nivalis var. *tenuis*	r
Cardamine bellidifolia f. *laxa*	vr
Draba fladnizensis s.l.	vr
Dryas integrifolia	vr (seedlings)
Stellaria longipes	(1)

The soil, which is distinctly acid in reaction, is darkened by humus only to a depth of 2 or 3 cm.; beneath this it is of yellowish clay. Cryptogams are of good growth but much mixed, the following being the most important in the area listed:

MUSCI	*Aulacomnium turgidum*
	Polytrichum hyperboreum
	Rhacomitrium lanuginosum
HEPATICAE	*Gymnomitrium concinnatum*
	G. corallioides
	Ptilidium ciliare
LICHENES	*Cetraria crispa*
	Cladonia coccifera var.
	C. mitis
	C. uncialis
	Dactylina arctica
	D. ramulosa
	Ochrolechia frigida ?
	Peltigera aphthosa s.l.[1]
	P. scabrosa
	Solorina crocea
	Sphaerophorus globosus
	Stereocaulon alpinum
	Thamnolia vermicularis

Zone II. In the southern parts of our area the zone lying directly within the *Cassiope* is typically dominated by Salices, but in the present instance this appears to be telescoped into the adjacent parts of other zones—especially into the inner parts of the *Cassiope* zone, where *Salix herbacea* is very plentiful and where such recognized members of the late-snow cryptogam contingent as *Solorina crocea* and *Gymnomitrium corallioides* occur. This second zone in the example listed at Clyde corresponded rather to the third or fourth (herb "barren") zone developed farther south, although it tended to be better vegetated; it lacked appreciable humous accumulation and supported an open community of herbs with rather few associated cryptogams:

SPERMATOPHYTA	*Luzula confusa*	a
	Oxyria digyna	f-la
	Salix herbacea	o-la
	Luzula nivalis	f
	Ranunculus pygmaeus	f
	Salix arctica	o-f
	Alopecurus alpinus	o
	Ranunculus nivalis	o
	Saxifraga cernua	o
	S. nivalis	o
	Cassiope tetragona	r (vegetative only)
	Potentilla hyparctica (*P. emarginata* var. *typica*)	r

[1] *See* Part II of the present series, p. 313.

	Papaver radicatum	(1)
	Potentilla hyparctica f. *tardinix*[1]	(1)
	Saxifraga stellaris var. *comosa ?*	(1)
BRYOPHYTA	*Gymnomitrium concinnatum*	
	G. corallioides	
	Polytrichum norvegicum	
LICHENES	*Cladonia pyxidata* var. *pachythallina*	
	Ochrolechia sp. (sterile)	
	Solorina crocea	
	Stereocaulon sp. (sterile)	

The *Salix* plants in this zone still retained most of their leaves in a green condition toward the middle of September in 1934 and 1936, although by this time, on almost all areas around, the leaves had become brown or had already fallen. This, coupled with the late melting of the snow in zone II; indicates a periodicity of a type already noted in Lapland (Polunin 1935a, p. 167).

Zone III. The third zone is characterized by a paucity of phanerogams and an almost proportionate increase in mossiness, due to the more lastingly damp conditions, although no true moss-mat was developed except very locally in the run-off from the melting snow. In spite of the fair growth of some of the Bryophyta, plants of any kind covered only about one-fifth to one-twentieth of the area, the chief species being:

SPERMATOPHYTA	*Phippsia (Catabrosa) algida*	o-f
	Luzula confusa	o
	Saxifraga nivalis	r
	S. rivularis	r
	Luzula nivalis	vr
BRYOPHYTA	*Andreaea crassinervia*	
	Bryum sp. (sterile)	
	Gymnomitrium corallioides	
	Polytrichum norvegicum	
	Psilopilum laevigatum	
LICHENES	*Cladonia pyxidata* var. *pachyphyllina*	
	Stereocaulon alpinum ? (sterile)	
	S. rivulorum	

There is no appreciable humous deposit, and even the rocks are largely devoid of crustaceous lichens, although a few (generally sterile) specks of *Lecidea* spp. are usually to be found. Flowering of the phanerogams is deficient and their growth extremely poor, even the Luzulae being only 3-6 cm. in height.

Zone IV. This central area, seen around the persistent patches of snow in Plate XXXIX, where probably the snow sometimes does not melt at all in "bad" years, is characterized by the complete absence of vascular plants and often also of lichens. The growing-season is reduced to a very few weeks or even days in late summer, the terrain being a barren and almost exclusively mineral fjellmark, although a little humus may be deposited from debris blown on to the snow in early summer. The larger frost-shattered particles and chunks of rock are not secondarily weathered but left jagged and barren, those in the photograph appearing almost as light in colour as the adjacent patches of rather dirty snow. Although the "soil" is lastingly damp, vegetation is generally limited to a few Algae that may form thin investments on mud or the undersides of stones, and such small mosses as *Andreaea crassinervia*, which, with sterile tufts of *Bryum*, may help bind the surface although rarely attaining continuity over areas more than a few centimetres in extent.

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[1] *See* footnote (2) on p. 55.

(v) FRESHWATER

The persistent freshwater streams of various sizes encountered at Clyde were poorly vegetated, although the bed in some places where it was gravelly or bouldery was darkened by a fair growth of such mosses as *Calliergon sarmentosum* and *Drepanocladus fluitans*. On or among these mosses were found in one place where the flow was quite rapid, and where arctic char of goodly size abounded, the following Algae, which comprise something of a "mixed bag", although this and the next list do not include the Diatomeae that were present:

Arthrodesmus ralfsii
Chamaesiphon incrustans var. *elongatus*
Cosmarium bioculatum
C. cucumis
C. paucigranulatum
Microspora willeana
Plectonema tomasinianum var. *gracile*
Staurastrum crenulatum
S. dilatatum
S. muticum
S. vestitum

In slow eddies a scum or wefts of filamentous or other Algae sometimes occurred, which in one example included the following:

Ankistrodesmus falcatus
Aphanocapsa arctica
Aphanothece castagnei
Chamaesiphon cylindricus
Cladophora sp.
Cosmarium bioculatum
Hyalotheca dissiliens
Microspora pachyderma
Spondylosium planum
Staurastrum glabrum
S. inflexum
Zygnema sp. (sterile)

Compared with most of those observed to the north and especially to the south, the numerous shallow lakes at Clyde were also rather poorly vegetated, at least around their margins, which alone I had an opportunity of investigating. Moreover, the water of some of them may have been slightly brackish. Thus, where the bottom was of sand or mud it was often quite devoid of macroscopic plants, although where it was studded with stones or large boulders, which exerted some stabilizing influence, there were sometimes limited dark brown beds of such aquatic mosses as *Calliergon sarmentosum* and *Calliergidium pseudostramineum*. Brown or reddish scrapings taken on September 15, 1936, from three rocks in one lake yielded the following quite numerous Algae (including Diatomeae):

Achnanthes minutissima var. *cryptocephala*
Aphanocapsa grevillea
Arthrodesmus ralfsii
A. triangularis
Chamaesiphon cylindricus on *Tolypothrix limbata*
C. incrustans on *Tolypothrix limbata*, etc.
Closterium parvulum
Cosmarium baffinensis
**C. curtum*
**C. cyclicum* var. *crassum*

* Also found on the sandy bed of a dried-up streamlet nearby.

C. poluninii
C. subcrenatum
Cymbella aequalis
C. microcephala
C. rabenhorstii
C. ventricosa var. *semicircularis*
Diatoma tenue var. *pachycephalum*
Dinobryon sertularia
Draparnaldia plumosa
Eunotia curvata
E. fallax var. *gracillima*
E. lapponica
E. naegelii
E. pectinalis var. *minor*
E. perpusilla var. *perminuta*
E. praerupta var. *genuina*
E. septentrionalis
E. veneris
Frustulia rhomboides var. *crassinervia*
Gonatozygon kinaharii
Lyngbya lagerheimii
**L. nana*
L. ochracea
L. versicolor
Melosira granulata
Microspora quadrata
M. stagnorum
Navicula brachysira
N. cocconeiformis
N. contenta var. *typica*
N. maculosa
N. minima var. *typica*
N. rotaeana
N. zellensis var. *linearis*
Neidium bisulcatum
Nitzschia frustulum
N. palea
**Oocystis borgei*
Ophiocytium parvulum
Oscillatoria irrigua
O. tenuis
Pinnularia borealis
P. divergentissima var. *hustedtiana*
P. fasciata var. *inconstantissima*
P. globiceps var. *krookii*
P. microstauron
P. parvula
Schizothrix braunii
Staurastrum anatinum
S. bieneanum
S. margaritaceum
S. muticum
S. pachyrhynchum
S. polymorphum
Stauroneis anceps var. *amphicephala*, var. *hyalina*, and var. *linearis*
**Symploca muscorum*
Synedra amphicephala
S. tabulata var. *obtusa*
Tabellaria fenestrata
T. flocculosa
**Tolypothrix limbata*

* Also found on the sandy bed of a dried-up streamlet nearby.

In some places where the water is very shallow, limited beds of *Pleuropogon sabinii* or *Ranunculus hyperboreus* are to be found, both with floating leaves, and in some sheltered situations there may be more extensive "swamps" of *Eriophorum scheuchzeri, E. angustifolium, Dupontia fisheri,* or *Carex aquatilis* var. *stans.* Distribution is very irregular, being dependent apparently to a large extent on chance dispersal; for much more often, even where conditions seem suitable for colonization by these or other marsh or semi-aquatic types, the margins of lakes are largely barren. Even adjacent muddy areas are only irregularly vegetated, as is seen in Plate XXXVII, where there is not a little open water. Humous deposits and stabilized lake-marginal ramparts or "hard lines" are largely lacking, the whole area appearing "young"; but on patches of wet mud a brown investment of Algae is frequently developed, which in one instance included the following (apart from Diatomeae):

Ankistrodesmus falcatus
Aphanocapsa grevillea
Chroococcus turgidus
Closterium abruptum
C. pusillum var. *major*
C. rostratum
C. striolatum
C. venus
Cosmarium subcrenatum
Cylindrocystis brebissonii
Euastrum binale
Hyalotheca dissiliens
Lyngbya stagnina
Merismopedia elegans
M. glauca
Oscillatoria tenuis
Pediastrum tetras
Penium libellula var. *intermedium*
Staurastrum muticum

(vi) SEASHORE

The larger plants characteristic of sandy and shingly strands at Pond Inlet and to the south were not seen at Clyde, but where the shore was of fine sand and slightly shelving, or, better still, in muddy brackish depressions behind tide-washed bars, a dwarfed "saltmarsh" community was developed, dominated as usual by *Puccinellia phryganodes* with associated *Carex ursina* and *Stellaria humifusa.* The only other frequent associates were *Puccinellia paupercula* and *Cochlearia officinalis* (var. *oblongifolia* and var. *groenlandica*), the community being generally far from closed. Away from the immediate influence of salt water, *Phippsia (Catabrosa) algida* was in places abundant and *Deschampsia pumila* occurred. Between tide-marks a few Algae were to be seen—especially *Fucus vesiculosus* and *Hormiscia penicilliformis* growing on boulders. The communities farther down were not investigated; nor were many large Algae to be found cast up on the shore in this sheltered cove.

It seems fitting to close this account of the vegetation of Clyde with an observation made there twice but not repeated in my years of botanical exploration in various arctic lands, viz., *Carex ursina* growing well inland and away from the influence of the sea. This strongly supports the supposition mentioned above that much of the area has emerged from the sea only in comparatively recent times—which would, coupled with the exposed coastal position, help to explain the smallness of the flora and the lack of extensive humous deposits.

Plant Communities Around Pangnirtung

Pangnirtung is the large settlement situated in latitude 66° 6′ N., longitude 65° 30′ W., on the east bank of the long fiord of the same name, which runs in a north-northeasterly direction from the north coast of Cumberland Sound. The settlement is also the regional headquarters of the Hudson's Bay Company, R.C.M.P., and various medical and missionary activities, and is visited annually by the Eastern Arctic patrol ship.

The local physiography is extremely rugged; for although the fiord has its almost straight sides bounded by gently sloping outwash plains, these rapidly increase in incline away from the water's edge (cf. Soper 1928, photo A on p. 131), and lead to precipitous sides, which in turn give rise to jagged peaks (*ibid.*, photo B) and mountains that may exceed 5,000 feet (1,524 m.) in height. Not far away are peaks reported to exceed 8,000 feet (some recent United States aviators say 10,000 feet).

The geology is comparatively simple, the rock being a greyish granite of Precambrian age, which frequently gives a dull reddish colour on weathering. Although the texture may vary from place to place, the granite is generally rather coarse-grained; small pegmatite dykes are very numerous (Weeks 1928, p. 92c). The country has been intensely glaciated and even now supports local ice-caps of considerable extent. The seaside terraces are very bouldery and composed of the usual rewashed glacial deposits. The slopes near the sea are in most places gentle, but they rise rapidly behind, in an even curve to meet the ongoing cliff, scree, or steep mountain slope. The effect of the levelling tendency of solifluction is evident over considerable areas. However, ancient beaches are to be found in suitable places up to altitudes of about 600 feet (183 m.). They indicate a considerable uplift, at all events locally, and suggest that most of the lowlands near the sea have emerged only in relatively recent times. Wherever tested the soils lacked calcareous materials and were distinctly acid in reaction.

Insects are noticeably more plentiful than to the north. Thus in 1934 I saw several bumble-bees as late as the first week of September. They largely ignored the more showy flowers, including *Pyrola grandiflora*, but actively visited late-flowering bushes of *Salix cordifolia* growing in late-snow areas.

An account of the main features of the climate has been given above; it is much more favourable than at the Pond Inlet post, allowing a far greater variety of vegetables to be grown under glass, often to a very useful size. Nevertheless, it is a very windy and rather foggy place.

(i) MOUNTAINS AND UPLANDS

These occupy most of the land area for many miles around. My few days spent at Pangnirtung have unfortunately been too brief to allow me to scale the higher peaks, or even to visit the head of the fiord where the vegetation is said to be more luxuriant than around the settlement[1]. However, one fairly substantial climb was accomplished during which a small summit was visited in good weather. This was at an altitude of approximately 2,500 feet (762 m.). The surface had evidently been glaciated, for it was domed and strewn with rounded boulders. These, even more than the stony gravel between them, were generally dark with lichens; but vascular plants were almost absent, being

[1] I have seen a flowering specimen of *Epilobium angustifolium* nearly a metre in height that had been brought by Eskimos from the head of the fiord, where conditions may be expected to be unusually favourable (cf. Polunin 1941a, p. 326, and MS.h).

limited to occasional small tufts of *Luzula confusa* and very rare ones of *Hierochloe alpina* and *Cardamine bellidifolia*. Such an area is seen in Plate XL, which was, however, taken lower down on the plateau. On the actual summit even mosses were largely confined to slight depressions, the very mixed selection of lichens given in the list below forming virtually the whole of the plant investment. Of these cryptogams, the larger species grow best in sheltered depressions or crannies afforded by surface irregularities. The "soil" was coarse and grey and largely devoid of humus.

BRYOPHYTA	*Chandonanthus setiformis*	
	Polytrichum hyperboreum	
	P. norvegicum	
	Rhacomitrium lanuginosum	
LICHENES	*Alectoria nigricans*	va
	A. ochroleuca	a
	Cetraria nivalis	la
	Stereocaulon alpinum	la
	Cladonia mitis	f
	Cornicularia divergens	f
	Haematomma ventosum var. *lapponicum*	f
	Parmelia pubescens	f
	Sphaerophorus globosus	f
	Cetraria hepatizon	
	Cladonia alpicola	
	C. coccifera var. *stemmatina*	
	Ochrolechia frigida ?	
	Parmelia alpicola	
	P. saxatilis	
	P. separata	
	Sphaerophorus fragilis	
	Stereocaulon denudatum	
	S. rivulorum	

It is worthy of note that *Luzula confusa*, which is generally the chief and often the only vascular plant at high altitudes (cf. Polunin 1938, p. 91), tends also to persist far into the snow-patches. Evidently, then, it is able to vegetate very quickly in the much shortened growing-season as well as withstand extremes of cold and exposure, being altogether among the hardiest and most typically high-arctic of all plants.

Although details of composition and luxuriance may vary considerably from place to place, some such poor lichen "barrens" probably occupy more of the area around Pangnirtung than does any other type of terrain. Thus Plate XL shows an extensive area of plateau at 2,200 feet (671 m.) vegetated almost exclusively by lichens of comparatively poor growth, and interrupted in places by perennial patches of snow around which the vegetation may be even poorer, the entire aspect being one of extreme desolation. However, in suitable places this 'cold desert' is relieved by limited tracts of dry or wet tundra, where the vegetation is more or less closed, even though the whole area was probably glaciated until relatively recent times.

An example of the drier type of upland tundra is seen in Plate XLI. It is best developed on flats or slight south-facing slopes in sheltered depressions, which are covered with snow in winter, and is "grassy" in appearance. The chief dominants in the example seen in Plate XLI are *Luzula confusa*, *Hierochloe alpina*, and *Carex bigelowii*. *Salix herbacea* is the chief "filler", with cryptogams of which the chief are Cetrariae (especially *C. crispa*), Cladoniae (especially *C. mitis*), *Polytrichum hyperboreum*, and *Rhacomitrium lanuginosum*.

PLATE XL

Lichen barrens at 2,200 feet (671 m.), looking south. Note the virtual absence of higher plants and the abundance of snow-patches on north-facing slopes. Pangnirtung, C. Baffin, Sept. 4, 1934.

PLATE XLI

Dry grassy tundra in depression at about 2,100 feet (640 m.), with snow-patches persisting around. Pangnirtung, C. Baffin, Sept. 4, 1934.

Phanerogamic associates are variable but rather few, being in most places limited to occasional individuals of *Luzula nivalis, Cardamine bellidifolia,* or *Epilobium latifolium. Cassiope tetragona* and *Lycopodium selago* are to be found in some depressions.

The wet tundra is developed about standing or percolating water that spreads to cover many surfaces on upland plains where rock or frozen subsoil impedes drainage. The chief plants are *Eriophorum angustifolium, E. scheuchzeri,* and *Carex bigelowii* (including phases approaching *C. aquatilis* var. *stans*), and they may be mixed or they may form almost pure patches individually. Although all of the species mentioned in the previous paragraph from the dry tundra are to be found on raised tussocks, the more characteristic phanerogamic associates are *Juncus biglumis, Saxifraga nvalis* var. *tenuis,* and *S. stellaris* var. *comosa.* Often there are no others. Nor are lichens much in evidence, except for sometimes *Sphaerophorus globosus* and *Stereocaulon denudatum.* On the other hand, bryophytes, particularly *Cymnomitrium corallioides,* largely cover the damp surface, or clothe the rocks from which water from late-melting snow flows slowly but lastingly. The following were the most important in one area:

Andreaea rupestris
Anthelia julacea
Aulacomnium turgidum
Calliergon sarmentosum
Cephalozia fluitans
Gymnomitrium corallioides
Polytrichum hyperboreum
P. norvegicum
Scapania irrigua
Sphagnum fimbriatum

Besides the various species mentioned above, about twenty-five other phanerogams were seen to be of fairly frequent occurrence above 2,000 feet (610 m.), including Potentillae and *Lychnis furcata;* several were seen even around the snow-line above 3,000 feet, to which region *Antennaria compacta* appeared to be confined (*See* Part I, p. 353). On the other hand, closed "blueberry heaths" and bushy Salices were not encountered above 1,500 feet—to which altitude it seemed even from my limited explorations that the majority of the ordinary land plants of lower altitudes could persist.

(ii) LOWLANDS

The lowland flats and slopes near the fiord are very variously vegetated. The fiord is deeply gouged and almost straight, and its sides are frequently scoured by strong winds that rush along it; accordingly, we find the most luxuriant vegetation developed chiefly in sheltered depressions and side valleys. Here, especially along the margins of streams, a thin scrub of *Salix cordifolia* var. *callicarpaea*[1] up to 60 cm. in height is frequently encountered, or, still more locally and much more rarely, low *Betula nana* on comparatively deep sphagnous bog (*See* Plate XLII). Plate XLIII shows in the foreground a low *Salix* scrub thinning out to luxuriant grassy "heath", the whole being developed in the shelter of heaps of dark morainic boulders; the steep fiord-side slopes and mountains seen in the distance give some impression of the rugged nature of the country.

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[1] Often infected with *Rhytisma salicinum.*

Plate XLII

Low scrub of *Betula nana* with associated *Salix cordifolia* var. *callicarpaea*. The *Betula* is only 15 to 20 cm. high (scale given by pipe near centre). Pangnirtung, C. Baffin, Sept. 5, 1934.

Plate XLIII

Low *Salix* scrub passing behind into grassy heath developed in shelter of moraine. In the distance are rugged fiord-side slopes and mountains. Pangnirtung, C. Baffin, Sept. 3, 1934.

Perhaps less significant than the above, but far more important as coverers of a vastly greater proportion of the lowland areas, are the various heathy and damp tundra communities characteristic of the fiord-side outwash plains. Three main types can be distinguished, though many intermediate stages are to be seen and all are liable to interruption by lichenous boulders and other facies.

PLATE XLIV

Luxuriant facies of "blueberry heath" with *Ledum* locally dominant. Just above mouthpiece of pipe are leaves and flowers of *Pyrola grandiflora*. Pangnirtung, C. Baffin, Sept. 5, 1934.

(1) On banks and dry slopes that are not too steep, the characteristic community is a poor mossy heath whose area is chiefly occupied by the moss *Rhacomitrium lanuginosum,* which gives it a light, silvery grey colour (*See* Plate XLV; the other extreme is seen in Plate XLVI, which shows a nearby marshy tract). The surface undulations are sometimes due to underlying boulders, but more often to the uneven, rather tussocky growth of the moss. The predominant mixed ground-shrubs and grasses vary in frequency but rarely cover more than one-sixth of the area; indeed the flora, especially of associated cryptogams, tends to be small owing to the control exercised by the ubiquitous moss, which is so luxuriant that the feet may sink 10 cm. into it. Although the snow-covering is rather slight, several species of fruticose lichens grow rather well, in some places forming a luxuriant "reindeer-moss" sward 8-12 cm. thick; indeed this is one of the communities which makes me think that the area might be suitable for colonization by domesticated reindeer, quite possibly affording adequate feed and shelter in both winter and summer—if only the local sledge-dogs could be controlled. A typical small area, which appeared to have been infested with lemmings, yielded the following list:

Spermatophyta	*Hierochloe alpina*	a
	Salix arctica (incl. var. *kophophylla*)	f-a
	Vaccinium uliginosum var. *alpinum*	f
	Cassiope tetragona	o-f
	Salix herbacea	o-f
	Carex bigelowii	lf
	Poa arctica	lf
	Ledum palustre var. *decumbens*	o
	Luzula confusa	o
	Rhododendron lapponicum	o
	Luzula nivalis	r
	Polygonum viviparum	r
	Cardamine bellidifolia f. *laxa*	vr

Plate XLV

Mossy "heath" on dry fiord-side slope. Most noticeable are the light-coloured covering of ***Rhacomitrium lanuginosum*** and axes of associated grasses; also prostrate ***Salix arctica*** in the foreground. Pangnirtung, C. Baffin, Sept. 3, 1934.

PLATE XLVI

Looking uphill: a marshy tract meandering down from the foot of a mountain toward the side of the fiord, and dominated by *Eriophorum angustifolium.* Pangnirtung, C. Baffin, Sept. 5, 1934.

BRYOPHYTA[1]	*Rhacomitrium lanuginosum*	va(d)
	Lophozia atlantica	
	L. attenuata	
	Polytrichum hyperboreum	
LICHENES[1]	*Sterocaulon alpinum*	a
	Alectoria nigricans	
	A. ochroleuca	
	Cetraria nivalis	
	Cladonia amaurocraea	
	C. elongata	
	C. mitis	
	C. rangiferina	
	Cornicularia divergens	
	Sphaerophorus globosus	
FUNGI[1]	*Cintractia caricis* on *Carex bigelowii*	
	C. luzulae on *Luzula confusa*	

[1] The few more casual or rare cryptogams have been omitted from the list.

Although the thick and continuous sward keeps the substratum well insulated, there is remarkably little humus below; indeed the areas give the impression of having been colonized only in comparatively recent years, the light-coloured, gritty soil being almost entirely devoid of organic matter, although distinctly acid in reaction (pH 5·4-5·8). Even as most upland areas were probably glaciated until comparatively recent times, it seems likely that many of the lower slopes emerged not so long ago from the sea, the uplift in this region having been considerable (cf. Weeks 1928, pp. 90-91c). Indeed on some exposed mounds the cryptogams have failed to take a hold and the community to this day remains open, with much the same phanerogams dotted about the exposed gravelly surface as were listed above, and, in addition, *Diapensia lapponica, Dryas integrifolia, Kobresia myosuroides* (*K. bellardi*), and *Silene acaulis* var. *exscapa.*

(2) On more favourable, less exposed though well-drained slopes and some flats in sunny situations there is developed a luxuriant blueberry heath in which associated ground-shrubs may be co-dominant with the *Vaccinium.* In especially sheltered spots, such as the one shown in the centre of Plate XLIII, the *Vaccinium* may grow 25 cm. high; more typically it is only 5-10 cm. high but nevertheless produces an abundance of delicious fruit. Except that lichens are more in evidence and the ground-shrubs are more luxuriant (frequently they are almost continuous over areas of several square metres), as in the foreground of Plate XLVIII, this mixed heath is reminiscent of the one developed on favourable slopes at Pond Inlet and shown in Plate XXVIII; the dominance is, however, more overwhelming and the associated flora smaller, as is indicated by the following list from a 4-metre quadrat. Of the rather various cryptogams which were present, only the more important species need be noted:

SPERMATOPHYTA	*Vaccinium uliginosum* var. *alpinum*	vad
	Ledum palustre var. *decumbens*	f-acod
	Cassiope tetragona	la
	Empetrum nigrum var. *hermaphroditum*	f
	Luzula confusa	f
	Salix arctica	f
	Poa arctica	o-f
	Arctostaphylos alpina	o
	Carex bigelowii	o
	Salix arctophila	o
	S. herbacea	o
	Hierochloe alpina	r
	Pyrola grandiflora	r
	Stellaria longipes	r
	Pedicularis hirsuta	vr
	Ranunculus lapponicus	vr
MUSCI[1]	*Dicranum groenlandicum*	
	Hylocomium splendens	
	Polytrichum hyperboreum	
	P. strictum	
	Rhacomitrium lanuginosum	
LICHENES[1]	*Cladonia cyanipes*	
	C. deformis	
	C. elongata	
	C. uncialis	
	Nephroma arcticum	
	Stereocaulon alpinum	
FUNGI[1]	*Exobasidium vaccinii-uliginosi* on *Vaccinium uliginosum* var. *alpinum*	
	Cintractia caricis on *Carex bigelowii*	

[1] Only the chief species are listed.

The ground-shrubs rooted chiefly in the uppermost 5 cm. of soil, which was here rich and peaty; below there was a fair admixture of humus to a depth of 12 cm. The pH was 5·6. Although the surface tended to be parched by the sun, at least where the ground-shrubs were not thick, there was below, even in autumn, a plentiful supply of water around the roots of the dominants. An unusually luxuriant facies shown in Plate XLIV has *Ledum* locally dominant, *Vaccinium* abundant, and, just above the mouthpiece of the pipe, *Pyrola grandiflora* in flower.

(3) The gentle inclines down to the fiord margin are in many places well supplied with water from the steeper slopes behind and, where this water is retained on and spreads out over the surface—as is frequently the case in these regions of permanently frozen subsoil—are vegetated by a damp mixed tundra community rather reminiscent of the one described above from Clyde. Indeed the flora is often so nearly identical in the two places that it would be superfluous to list a Pangnirtung example here. The more notable additions to this community or its facies in the latter place are *Carex rariflora, Eriophorum spissum, Juncus castaneus, Luzula spadicea* (including var. *wahlenbergii*), *Poa nascopieana, Ranunculus lapponicus,* and *Salix arctophila,* none of which has been found anywhere around Clyde; on the other hand, none of the species that is characteristic of this community at Clyde is absent from any major tract of it at Pangnirtung. At the latter place a rather frequent feature is the appearance of dynamic and barren mud "polygons" or circles on the surface, which disturb the otherwise continuous sward; the community also tends to be more "heathy" than at Clyde, *Vaccinium uliginosum* var. *alpinum* being sometimes quite abundant and *Eriophorum angustifolium* proportionately less plentiful. However, all manner of local variations can occur, chiefly in relation to local changes in water relationships. In most places mosses form a continuous investment 20-25 cm. deep, into which the feet may sink as much as 12 cm. Beneath comes a thin layer of humus, whose pH where tested was 5·6, and then light brown mineral soil that is unfrozen to a depth of at least 40 cm. in summer. The most characteristic cryptogams of the less damp areas, which include numerous lichens and some Fungi, seem sufficiently dissimilar from the Clyde contingent to be worth listing:

MUSCI	*Aulacomnium turgidum*	a
	Rhacomitrium lanuginosum	a
	R. canescens	f
	Calliergon sarmentosum	
	Conostomum boreale	
	Hylocomium splendens	
	Oncophorus wahlenbergii	
	Polytrichum hyperboreum	
HEPATICAE[1]	*Chandonanthus setiformis*	
	Gymnomitrium corallioides	
	Ptilidium ciliare	
LICHENES[1]	*Stereocaulon alpinum*	a
	Alectoria nigricans	
	A. nitidula	
	Cetraria delisei	
	C. cucullata	
	Cladonia amaurocraea	
	C. coccifera var.	
	C. elongata	
	C. mitis	
	C. uncialis	

[1] Only the most characteristic species are listed.

	Dactylina arctica
	Peltigera aphthosa
	P. scabrosa
FUNGI[1]	*Cantharellus brownii ?*
	Humarina leucoloma
	Omphalia umbellifera

Where drainage is better, as for example in the stream-dissected terrain seen in Plate XLVII, dwarf Salices tend to predominate; on the other hand, where drainage is poor but water is plentiful, as for example in depressed areas of slight gradient toward the gently sloping bottoms of the outwash plains, *Eriophorum angustifolium* tends to be overwhelmingly dominant, frequently "paving the way" down to the sea in the manner shown in Plate XLVI.

PLATE XLVII

Stream-dissected terrain showing well-drained banks vegetated by dwarf Salices. The surrounding, poorly drained area is of damp, mixed tundra. Pangnirtung, C. Baffin, Sept. 3, 1934.

(iii) MARSHES

Various types of marshy area have been described above, both from the uplands and the lowlands, a good example from the latter being figured in Plate XLVI, which shows a long tract dominated by *Eriophorum angustifolium* stretching from the bottom of a mountain almost to the sea. This is developed in a depression only a few inches lower than the surrounding damp tundra, whose flora affords the chief associates here also, viz., *Carex aquatilis* var. *stans, Eriophorum scheuchzeri* and *E. spissum, Arctagrostis latifolia, Dupontia fisheri, Luzula nivalis* and *L. spadicea, Polygonum viviparum, Salix arctophila,* etc. These are also generally the chief plants of the marshes bordering bodies of

[1] *See* footnote on p. 124.

standing water in the district. Lichens are rare or locally absent but mosses form a continuous investment, even if they are obscured by the taller phanerogams. The chief mosses in one small area were:

Aulacomnium palustre
A. turgidum
Calliergon stramineum
Drepanocladus exannulatus
Oncophorus wahlenbergii
Polytrichum alpinum
Sphagnum capillaceum var. *tenellum*
S. teres

(iv) SNOW EFFECT

The communities developed in relation to deeply drifting snow are so similar, especially in composition, to those described above from Clyde, which lies in the same major district, that only a few extra notes need be given here. The vegetation inhabiting sheltered situations being far more luxuriant at Pangnirtung than at Clyde, as should be clear from the above, the outermost zone where the covering of snow is good but does not melt very late is generally occupied by "blueberry heath" (*See above*) or bushy Salices. Plate XLVIII shows a snow-patch on a well-drained mountainside in which this peripheral zone, seen in the foreground, is of more luxuriant mixed blueberry heath than that inhabiting surrounding areas that have little snow-covering in winter. Farther in, sloping away from a point slightly behind the sledge-dog in the photograph, is seen a rather narrow *Cassiope* zone in which the dark tufts of the dominant are much interrupted by light-coloured lichens in the manner already described from Clyde, and inside this, forming a background around the sitting Eskimo, where the growing-season is more drastically shortened, is a broader zone dominated by *Salix herbacea*, generally with some Luzulae and grasses (*See* Plate XLIX). Still farther back lies the centre of the patch, where lichens are few and the area is a herb "barren" very like that described from Clyde; for here the snow disappears long before the end of summer, so that no more mossy or barren central zones are to be seen. Indeed, they are of rare occurrence in the lowlands at Pangnirtung, although, of course, plentiful on the mountains where the snow melts less rapidly. At Pangnirtung, as elsewhere, it is chiefly in late-snow areas that plants are to be found still flowering in late summer; the cause of this is obvious.

(v) AREAS OF BIOTIC DISTURBANCE

The large Eskimo settlement at Pangnirtung afforded a good opportunity of studying the anthropic influence, which, unlike the case in almost all other land areas of the world, is negligible in most parts of the Arctic. The sealskin tents of the settlement are pitched on slight, bouldery slopes near the water, the most notable feature from our point of view being the virtual lack of higher vegetation on the much trampled areas between the tents, and the grassiness of the terrain in most areas around. The trampled areas are filthy with refuse and the excreta of numerous sledge-dogs, but support in damp depressions a fine green carpet of *Prasiola crispa*, and in some drier places such angiosperms as *Phippsia (Catabrosa) algida*, *Cochlearia officinalis* vars., *Koenigia islandica*, *Poa glauca*, *Polygonum viviparum*, *Puccinellia angustata*, *Sagina intermedia*, *Saxifraga rivularis*, and *Stellaria longipes*. Away from the tents phanerogams and mosses become more numerous, to give way in less drastically disturbed but still occasionally manured areas to communities that are more exclusively grassy and

PLATE XLVIII

"Late-snow" patch showing in the foreground the outer zone of mixed "blueberry heath", then a narrow belt of dark *Cassiope tetragona* interrupted by light-coloured lichens, and behind, *Salix herbacea* and herb "barrens" occupying the centre of the late-snow area. Pangnirtung, C. Baffin, Sept. 4, 1934.

PLATE XLIX

Looking down on *Salix herbacea* zone toward centre of late-snow area. The surface from which the tiny Salix leaves protrude is largely of humus encrusted with *Gymnomitrium corallioides*. On the left are seen some young Luzulae. Pangnirtung, C. Baffin, Sept. 4, 1934.

extensively meadow-like than any others to be seen around. The chief grasses of such areas are *Poa arctica,* phases of *P. pratensis* s.l., *Alopecurus alpinus, Puccinellia* spp. (chiefly near the sea), and, in damper places, *Arctagrostis latifolia.*

Away from the settlement, man has had in almost all places no appreciable effect upon the vegetation, for in winter the ground is largely snow-covered and in summer the Eskimo leave their camps chiefly for the sea. However, some small influence of the biotic factor is generally to be found wherever the vegetation is carefully scrutinized; for lemmings abound, especially in certain years, and riddle the surface sward with their runs; arctic hares are plentiful, especially in the mountains, and eat down the more succulent, young tufts of *Eriophorum, Oxyria,* etc.; and caribou may eat and sadly trample the more luxuriant lichens in heathy areas during their winter feeding which may result in such a degree of denudation that the plants take many years to recover.

Finally should be mentioned the occurrence on otherwise almost barren prominences of occasional "bird-stones" of the type already described from Pond Inlet (cf. Plate XXV). A "close-up" of a Pangnirtung example is seen in Plate L, which shows the characteristic sward of *Hierochloe alpina* with upright axes about 35 cm. high, and on the right some *Luzula confusa.* On the ground just in the shelter of the boulder is developed a patchwork quilt of variously coloured lichens, much like that above bird-cliffs (cf. Polunin 1935, pp. 175-6, and Plate XVII, photo 3).

(vi) FRESHWATER

Open bouldery stream beds near the sea, which are washed only by torrents of snow-water in early summer and later dry out almost entirely, are colonized by such "open soil" or upland plants as the following, some of which were not encountered elsewhere in the lowlands:

Salix arctica	r-a
Epilobium latifolium	r-f
Arenaria rubella	
Cardamine bellidifolia	
Cerastium alpinum	
Draba fladnizensis	
Dryas integrifolia	
Festuca brachyphylla	
Hierochloe alpina	
Luzula confusa	
Papaver radicatum	
Poa arctica	
P. glauca	
Polygonum viviparum	
Saxifraga cernua	
S. nivalis	
S. oppositifolia	
S. rivularis	
S. tricuspidata	
Stellaria longipes	

Where the water is more permanent, the bed having frequently cut deep into the gravelly substratum, long tassels of green Algae and dark brown mosses sometimes occur. These, like the communities of standing water, tend to be more luxuriant than at Clyde, where, however, freshwater communities are far more numerous and extensive; much the same species are likely to be concerned in the two places.

Plate L

Luxuriant *Hierochloe alpina* 35 cm. high accompanying bird-stone on otherwise almost barren prominence. On the right are some dark axes of *Luzula confusa*. Pangnirtung, C. Baffin, Sept. 5, 1934.

Plate LI

Foreshore from near low tide-mark, showing boulders with sides covered by brown Algae (chiefly *Fucus vesiculosus* agg.), whereas the upper surface is kept bare by ice action. Pangnirtung, C. Baffin, Sept. 20, 1936.

Small areas of "red snow", in which the surface 1-2 cm. of late-lying snow patches were coloured a dull orange by *Sphaerella nivalis*[1], were noted both in the lowlands and on the mountain slopes at 1,200 feet (366 m.) in the first week of September 1934.

(vii) STRAND AND MARINE

Three of the most characteristic plants of dry sandy beaches above high tide-mark at Pond Inlet and elsewhere farther south in our area, viz., the local varieties of *Arenaria peploides, Mertensia maritima,* and *Elymus arenarius*[2], were to be found at Pangnirtung, although the suitable habitats there were of small extent. More important were members of the saltmarsh contingent, viz., *Puccinellia phryganodes, P. paupercula, Stellaria humifusa,* and *Carex bipartita* var. *amphigena,* which inhabited damp mud lower down near the water. Other plants characteristic of, but by no means confined to, the shore hereabouts were *Cochlearia officinalis* var. *groenlandica* and var. *oblongifolia, Koenigia islandica,* and *Montia lamprosperma.*

The tidal range at Pangnirtung is very considerable, the foreshore being of mud or boulders that have their upper surface kept bare of vegetation by ice action, although their sides and the sheltered areas between are generally covered by a luxuriant mat of Algae (*See* Plate LI). These are predominantly *Fucus vesiculosus,* as determined by Dr. Whelden (*See* Part II), although it seemed to me that several forms were represented. The only macroscopic Algae occurring on the exposed upper surface of the boulders were occasional minute squamules of the *Fucus* or the similarly abundant and wide-ranging *Pylaiella littoralis,* both of which were here largely limited to cracks.

Between tide-marks the *Fucus,* which had fronds up to a metre long, was almost everywhere so overwhelmingly dominant[3] that little zonation was to be observed except among some of the associated species. This fact affords some consolation for an accident on the expedition ship, which so destroyed the labels on my specimens that it is impossible to give an account of my detailed littoral survey carried out in 1936 when new snow and heavy frost curtailed work on land. All I can safely say is that the following species of varying life-form were found growing around or between the tide-marks, and that, except where the bottom was of mud, the larger laminarians took over the dominance just below low tide-mark, and farther down formed luxuriant beds:

Asperococcus echinatus
Calothrix pulvinata
Chordaria flagelliformis
Cladophora hystrix
Enteromorpha intestinalis
E. prolifera var. *arctica*
Fucus vesiculosus
Gloeocapsa crepidina
Halosaccion ramentaceum
Hildbrandtia[4] *prototypus*
Laminaria saccharina
Lithothamnion glaciale?
Lyngbya epiphytica on *Rhizoclonium* filaments
L. lutea

[1]Frequently referred to the genus *Chlamydomonas* as *C. nivalis* (Bauer) Wille by modern algologists, including Prof. F. E. Fritsch (*voce*), but not by Dr. Whelden in Part II of the present series, p. 46.

[2]*Carex maritima* and *C. ursina* have not yet been found in Cumberland Sound, although there can be little doubt that they occur there.

[3]These more luxuriant Fuci are reported by Kumlien (1879, p. 54) to constitute a favourite food for caribou in the district

[4]Concerning this orthography *See* Part II of the present series, p. 118.

Monostroma fuscum
Pylaiella littoralis
Polysiphonia fastigiata
Ralfsia verrucosa
Rhizoclonium riparium var. *validum*
Ulothrix speciosa

(5) SOUTHERN BAFFIN

This district includes all of Baffin lying south of a line drawn from the Arctic Circle (66° 32′ N.) on the west coast to Neptune Bay on the east coast, and also Loks Land, Resolution Island, and Big Island. The total land area is some 60,000 square miles, and the terrain extends from 66° 32′ N. southwards to about 61° 25′ N., and from 63° 30′ W. to 78° 20′ W. Although the topography is rugged, the coast being almost everywhere much indented and accompanied by innumerable islands of all sizes, the local physical features are in general less drastically variable than farther north on the east coast; they are described from so many points of view in the compilation of Millward (cf. 1930) that I need not enter into further details here, except to say that most of the country is comparatively low, especially in the northwestern plains, the physiographic changes being generally local and the hills rounded, although in many places elevations of around 3,000 feet occur (Soper 1936, pp. 428-9). The south coast is more than 400 miles (644 km.) long and there is one considerable ice-cap, the Grinnell Glacier, said to be 80 miles long. It is situated in the southeastern arm that cuts off Frobisher Bay from Hudson Strait. The southwestern extremity of the district is formed by Foxe Peninsula, which although lacking the rugged grandeur of so many parts of the east coast of Baffin, can nevertheless be imposing, especially around 'Cape' Dorset (cf. Soper 1930b, p. 400).

This whole southern Baffin area forms rather a good natural unit for our consideration.

GEOLOGY

This in the widest sense is rather simple, the rocks comprising only two main series—Archæan gneisses and granites, which occupy the whole of the east and south coasts and most of their hinterland, and Lower Palæozoic limestone, which occupies much of the country around Amadjuak Lake (c. 65° N.; c 71° 10′ W.) and almost all of the "great plains" to the northwest (cf. Manning MS.). A useful account of much of the south coast is given by its chief geological investigator, Dr. Robert Bell (cf. 1901, especially pp. 15M *et seq.*), who concludes that the country has been rather heavily glaciated. The limestone is mostly Ordovician, but a small exposure known as Silliman's Fossil Mount, situated near the head of Frobisher Bay, is said to be Silurian (Weeks 1935, p. 141). As examples of local complications in the Archæan country, we may take (1) the environs of Lake Harbour (*See* below), where there are outcrops of crystalline limestone and quartz, and also garnetiferous and micaceous beds of some possible value, and (2) Foxe Peninsula, which is Precambrian and "consists entirely of crystalline rocks among which granite, gneiss, greenstone, schists and white crystalline limestone were identified and in places heavy veins of well mineralized quartz. . . ." (Millward 1930, p. 59). Some useful notes on the physiography and geology of, particularly, this western end of southern Baffin are contributed by Gould (1928, pp. 29 *et seq.*), Gould, Foerste and Hussey (cf. 1928), and Manning (MS.). The limestone 'highlands' inland of the southeastern extremity of Foxe Basin are in places remarkably reminiscent

of those of Akpatok Island (cf. Gould 1928, illustrations on p. 35, Gould, Foerste and Hussey 1928, plates 1 and 2, and Polunin 1934, especially plates 27-29 and 32-36). Recent aerial photography shows that most other parts of Foxe Peninsula are very much more lake-dissected than had been supposed.

CLIMATE

The following tables give the more significant temperature and precipitation data for the 4 years 1931-4 from two stations on the south coast of Baffin, viz., Lake Harbour (*See* below), and Resolution Island.[1] Lake Harbour lies about

Month	Lake Harbour, 62° 52′ N., 69° 53′ W. Average 1931-4: Temperature °F. Max.	Min.	Monthly mean	Precipitation Inches	Snow or rain	Resolution Island. Average 1931-4: Temperature °F. Max.	Min.	Monthly mean	Precipitation Inches	Snow or rain
Jan.	19	−38	−13	0·78	S	21*	−27*	−3*	0·62*	S
Feb.	21·5	−41	−12	0·74	S	26*	−27*	−1*	1·61*	S
Mar.	30	−32	− 2	0·6	S	31*	−17*	8*	0·96*	S
April	42	−16	14·5	1·13	S	34*	− 5*	17*	1·39*	S and a little R
May	46	4	28	0·85	S and R	40*	14*	28*	1·63*	S and R
June	61	26	37	0·98	S and R	47*	25*	34*	1·42*	S and R
July	72	32·5	48·5	2·27	R	56*	30*	39*	1·96*	R
Aug.	66·5	32·5	47	1·81	R	53	29	39	1·8	R
Sept.	51*	25*	38*	1·82*	S and R	46	27·5	36	2·64	S and R
Oct.	42	6·5	28	1·31	S and R	40*	15*	30*	1·28*	S and R
Nov.	31	−14	9	1·31	S	32*	− 2*	20*	1·74*	S
Dec.	21	−33	− 8	0·49	S	25*	−16*	5*	1·79*	S

*Average for 3 years only.

halfway along the south shore and has a climate that is rather closely comparable with that of Pangnirtung (cf. table on p. 97), although its temperatures tend to be slightly higher, especially in winter, and its total precipitation is also rather heavier, averaging a little over 14 inches (35·5 cm.) per annum during the years 1931-4. Contrasted with these regions of rather continental climate we have Resolution Island, at the eastern end of Hudson Strait where this bounds on Davis Strait, markedly maritime in type[2]. Thus the mean temperature of the coldest month is generally a full 10°F. (5·5°C.) higher than at Lake Harbour, and the mean of the warmest month nearly 10°F. lower—being, in fact, appreciably lower than at Craig Harbour. The maxima and minima also show a far smaller amplitude at Resolution Island, where indeed all temperature changes tend to be smaller and slower, and the total precipitation is much higher (it averages about 19 inches annually) and more evenly distributed throughout the year. A little rain quite frequently falls as early as April, and it is a very foggy place (cf. Parry 1824, p. 9). Thus any benefit that may accrue from the mildness of the winter is more than offset by the cool summer. These conditions are evidently due to the peculiar situation at the junction of two ice-laden straits and almost on the border of the Atlantic Ocean, the climate at Lake Harbour being far more typical of the region and indeed of the Eastern Arctic as a whole, in which Resolution Island appears to occupy a climatic regime of its own.

[1] This island lies about 61° 35′ N. and 65° W., the meteorological station being situated in latitude 61° 18′ N., longitude 64° 53′ W.

[2] In this respect the map given by Connor (1930, maps on pp. 5 and 8) is hardly in accordance with the facts now known, as indeed the same author appears later to have recognized (1937, pp. 45-7).

VEGETATION

Once again it seems desirable largely to confine our consideration of the vegetation to a detailed description of the communities occurring at two widely separate and different localities within the major district. Indeed, apart from the following brief quotations and extra remarks that I have collected, rather little note has been taken of the vegetation of southern Baffin, however energetically the flora may have been pursued. Even the very useful compilation of Millward (cf. 1930) makes only occasional fleeting mention of the vegetation of this district, none of the remarks being considered worth repeating here.

The easternmost parts, which are so interesting floristically (cf. Polunin 1939), have unfortunately not been investigated vegetationally, though the rather naïve accounts of Hall (1864, I, pp. 309-310, and cf. vol. II) indicate that there may be an occasional "*oasis* in the great desert" in the form of quite wide grassy plains, especially well inland. Prof. David Potter informs me *(in litt.)* that Frobisher Bay supports luxuriant vegetation in many places, comparable (as is the flora) with parts of the Labrador coast. On the other hand, at Acadia Harbour, Resolution Island, growth is poor and the communities stunted. Mr. C. H. Knapp, late of the Hudson's Bay Company, corroborates the luxuriance of parts of Frobisher Bay, which he says are like some valleys inland of Lake Harbour.

Of the "easternmost of the Upper Savage Islands" (latitude 62° 31′ N., longitude 69° 57′ W.) Parry writes (1824, p. 18) "There was in some places a good deal of vegetation, and among the specimens collected, were several of those we had before met with in polar regions, especially the sorrel (*rumex digynus*),[1] scurvy grass, poppy (*papaver nudicaule*),[2] saxifrage (*saxifraga oppositifolia*), dwarf willow, and *andromeda tetragona,*[3] the latter being in flower, and growing in great abundance on the higher parts of the island". Lyon (1824, pp. 32-3) also writes interestingly of this same place, and, with powers of observation that, like Parry's, put most subsequent explorers to shame, remarks "In the marshy ground, near the water, the vegetation was extremely luxuriant. Amidst the various mosses and grasses, the delicate white flower of andromeda,[3] and brilliant yellow poppy, were eminently conspicuous. In drier places, a beautiful species of butter-cup was very abundant, as was also the dwarf-willow, of which I had heard so much, but had never seen before. This arctic tree grows close to the ground, and spreads its lilliputian branches over an extent of from one to three feet. Its stalk rarely exceeds three inches in circumference, and all the wood is twisted and deformed." This is all notwithstanding M'Keever (1819, p. 28).

Of Big Island, a little to the west of the Upper Savage Islands, Bell writes (1884, p. 21DD) "The hills have a rounded sweeping outline, and their summits are a considerable distance apart. The wide even spaces between them hold shallow lakes, surrounded with green meadow-like flats and mossy slopes . . . The general aspect of the landscape reminds one of some parts of the Highlands of Scotland".[4] Somewhat later (1901, p. 12M) Bell wrote, of summer on these central parts of the south coast of Baffin, as follows: "At this season the rocky Laurentian hills have generally a dark or nearly black appearance, owing to a growth of lichens upon them, but their sombre character is often relieved in

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[1]*Oxyria digyna.* (N.P.) [2]*P. radicatum.* (N.P.) [3]*Cassiope tetragona.* (N.P.)

[4] Even from some distance out to sea it is evident that Big Island is relatively well vegetated, the valleys preserving a continuous soft green appearance even on the rather exposed south coast. However, the vegetation is said to be all very dwarf—and in general much poorer on the coast than inland (cf. Bell 1901, photo facing p. 16M).

valleys and on hillsides by strips and patches of green, due to grasses and sedges in the lower parts and to a variety of flowering plants on sheltered slopes exposed to the sun."

Just to the north of the Upper Savage Islands lies Lake Harbour, whose vegetation will be described in detail below. The hinterland has been investigated by John Dewey Soper, who reports that "In a valley north of Lake Harbour . . . . clumps of willow . . . . range from six to ten[1] feet in height. This is the only place in Baffin Island where such growths are known to occur" (Soper 1930, p. 34). Even if Soper speaks of "the valleys of the mainland" as supporting "an impoverished carpet of lowly plant life" (1936, p. 431), he goes on to remark that "Farther inland, in sheltered nooks and dales and especially bordering rivulets and streams, the vegetation is markedly more luxuriant. Grasses and dwarf willows are frequently knee-high in restricted areas, and a wealth of bearberry, crowberry, white heather, and other shrubs and flowering plants decks the rocky valleys and the lower slopes of southern exposure" (*ibid.*, p. 432, fig. 5). Even the uplands may be well vegetated hereabouts, for Soper remarks (1936, p. 435) of one range of hills that "On the south-facing slope . . . . relatively rich vegetation was seen up to about 1,000 feet but was most notable up to 800 feet, where willow shrubs 2½ feet high were seen bordering a small brook. Beyond the 1,000-foot level the glaciated rocks were mostly barren".

Soper has also given a very useful account of the previously almost unknown plains bordering on Foxe Basin in the northwest of this major district, and continuing into central Baffin (*See* above). They are the nesting ground of the blue goose, a fact that inspired this all-round naturalist to make observations from which the following brief account has been mainly taken (*See* Soper 1930, pp. 30 *et seq.*). Also useful have been the notes of my old friend Thomas Manning (MS.), who frequently writes of "grassland", "grassy marshland", and even "close grass" in describing this region in which he has had more experience than, probably, any other white man.

The plains, which are low and swampy, are underlain by Ordovician limestone and shale and have a climate so adversely affected by the proximity of Foxe Basin, with its extensive ice-fields, that it is much less favourable than that of many areas to the east, or than most of the south coast of Baffin. In summer the pack-ice may afford numerous shore-stranded floes (Soper 1930b, photos 21 and 22 on p. 421, Soper 1930c, photo on p. 5). The vegetation, which is nevertheless locally continuous (Putnam 1928, p. 18 and photo 21 on p. 19, Soper 1930, photos on pp. 36 and 50, Soper 1930b, photo 16 on p. 420, Soper 1930c, photo on p. 4), is over considerable areas a closed marshy tundra dominated principally by such sedges as *Carex aquatilis* var. *stans*, and bound by mosses[2] with intermingled lichens. Although the vegetation is probably somewhat affected by pasturing by the geese in the area described by Soper, who remarks that they here almost denuded some grounds, that investigator "wondered at the marked dwarfishness and impoverishment of plant life here and over northern Foxe Peninsula"; nor does the list of associated phanerogams which he gives include any species that are not plentiful in such situations even much farther north. They are characteristic rather of the poorer types of marshes

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[1] Later reported as "more than 12 feet" inland of where "bushy clumps from three to four feet high were frequently seen" (Soper, 1936, p. 434). In a 'popular' article, which incidentally gives some splendid illustrations of Baffin Island 'flowers', Soper (1933, p. 113) reproduces a photograph of these willows which, being "12 feet, 6 inches in height. . .rank as by far the largest willows ever found in the eastern Canadian Arctic islands." For the taking of this photograph the willows appear to have been cut out and held up, though it can be seen that their stems are of the order of thickness at least of the holders' wrists; around is a luxuriant scrub, that shown on p. 115 of the same article appearing even thicker and higher. The tallest specimens are probably all *Salix planifolia* (*See* Part I, p. 172), and it appears likely that they are limited to areas where the deeper layers of soil remain unfrozen in an average winter (cf. Polunin 1933, pp. 313-4, and 1937, p. 939).

[2] Soper said "sphagnum mosses", but it is improbable that this genus was nearly as important as some others, at least on the limestone. (N.P.)

developed in exposed places or on slight slopes elsewhere in Baffin, and comprise *Eriophorum scheuchzeri*, which is noted as flourishing chiefly around the innumerable pools, *E. spissum*,[1] *Poa arctica, Carex membranacea, Arctagrostis latifolia, Alopecurus alpinus, Dupontia fisheri, Cerastium alpinum, Pleuropogon sabinii, Cardamine pratensis* var. *angustifolia*, and *Saxifraga hirculus*.[2] Various types of "polygons" or "mud circles" due to frost action occur, and, at intervals proceeding inland to the east, small isolated ridges of limestone or granitic material—in the latter instance supporting plants absent from the surrounding marshy plains, e.g., *Cassiope tetragona, Arctostaphylos alpina, Vaccinium vitis-idaea* var. *minor*, and *Empetrum nigrum* var. *hermaphroditum*. On the other hand, *Ledum* is nowhere to be found.

To the west and southwest the vegetation often remains similar and sometimes scant, particularly on the low coastal terrain, which is scoured and granitic (cf. Putnam 1928, photos 19 and 20 on p. 19, Soper 1930b, pp. 408 and 423), but to the south, as to the east, the vegetation becomes progressively less impoverished as Foxe Peninsula is crossed and the north shore of Hudson Strait approached (cf. Soper 1930, p. 34). On this coast farther west lies Cape Dorset, whose main plant communities are described in some detail below. According to Lord Tweedsmuir *(in litt. et voce)* they are fully characteristic of this southwestern corner of Baffin Island. On the other hand, the exposed northwestern extremity of Foxe Peninsula, Cape Dorchester, sounds far less well vegetated, having "countless freshwater ponds and pools . . . scattered through the rocky promontory. Patches of grass are few and far between, and vegetation is almost totally lacking, even moss and the customary heather-like dwarf shrubs being rare" (Putnam 1928, p. 16). To the south of Cape Dorchester, inland of Nuwata (65° 8′ N.), the vegetation appears to be less depauperate, for "there is a considerable amount of grassland intersected by glaciated hummocks of solid rock" (Manning MS.).

Plant Communities Around Lake Harbour

Lake Harbour is a narrow inlet on the south coast of Baffin, almost halfway along Hudson Strait. At its head, in latitude 62° 52′ N., longitude 69° 53′ W., lies the settlement of the same name. Here the Hudson's Bay Company established a trading post as early as 1911, and there have also for some years past been the regional (southern Baffin) headquarters of the R.C.M.P. and the Church of England in Canada.

Although the coastline is here rendered rugged by indentations and numerous accompanying islets, the country is less mountainous than on most of the east coast. Thus the greater part of the terrain adjacent to Lake Harbour, and much of the coastal fringe elsewhere, is comparatively low, rarely exceeding 600 feet (183 m.) in altitude. However, a few miles inland the land rises to about double this height, and some mountains reach 1,500 feet, there being thereafter a further gradual increase in elevation to the inland plateau (cf. Soper 1936, p. 430). Here the terrain is more gradually rounded and rolling, whereas near the coast it is changeable to a drastic degree, the country being just there one of intimate physiography and short-range aspect.

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[1] Not *E. callitrix* (the closely related species reported by Soper), at least according to the specimens preserved in the National Herbarium of Canada at Ottawa. (N.P.)

[2] Soper's mention of *Saxifraga oppositifolia, Salix reticulata*, and *Dryas integrifolia* as occurring chiefly along the river banks, just as they do in many places farther south, suggests that, even if it is not really luxuriant, the vegetation of the plains comprises a closed mat almost everywhere else. As most of these low-lying areas appear to have risen out of the sea only in comparatively recent times (cf. Manning MS.), this vegetation probably represents a preclimax—or possibly a pasturing subclimax in some places. (N.P.)

The fundamental rocks of this region are granites and gneisses, with bands of schist and crystalline limestone repeated several times at the surface as a result of faulting. The bands are 200 to 300 feet thick and dip 78 degrees northwest, being separated by bands of fine-grained quartz monzonite of about the same width (cf. Weeks 1928, p. 95C). In places quartzites and garnetiferous and micaceous schists also appear at the surface. The crystalline limestone, which is conspicuous in forming many of the slopes around the head of the inlet, is light grey in colour and disintegrates very readily into pea- and bean-sized crystals of calcite. The frequent areas of more or less mixed morainic material show signs of rewashing by marine agencies up to 600 feet, to which altitude "raised beaches" persist. Most of these deposits are rather highly calcareous, as limestone is plentiful in the region, over the whole of which glaciers appear to have pushed their way at some earlier date, rounding off any peaks or crags and transporting and mixing the material in considerable abundance. Climatic details of this "Riviera of Baffin Land," with its good 4 months' growing-season (including much sunny weather during 3 months throughout which there is frequently an entire absence of frost), have already been given above. It should, however, be noted here that although the climate of Lake Harbour is probably to a large degree representative of that obtaining for considerable distances around, Lake Harbour itself is an unusually well sheltered and "early" place, supporting vegetation that is obviously more luxuriant than in most other places bounding Hudson Strait.

(i) HILL SUMMITS AND SLOPES

The occasional hills that exceed 600 feet in the vicinity of Lake Harbour have flat or rounded summits supporting some of the poorest communities of the district, although similar terrain and accompanying vegetation may also occur near sea-level in the most exposed or otherwise unfavourable situations, especially on the crystalline limestone. Indeed one hilltop, 700 feet (213 m.) in altitude and the highest for some distance around, whose rock was of rapidly weathering schist, had its flat surface relatively well vegetated. Rock faces and projecting boulders occupied about half the area and were practically covered with crustaceous lichens and Gyrophorae; between lay depressions that were generally filled with coarse sand or gravel and supported quite numerous vascular plants, especially ground-shrubs. These sometimes formed closed mats very locally, but were more often spaced out in an investment of lichens, which in most places occupied at least half the area—even where there was finely comminuted "soil". A typical area gave the following list, which shows that a number of mosses are also to be found, although generally they are of poor growth except in damp depressions, where even *Sphagnum capillaceum* var. *tenellum* may be collected:

SPERMATOPHYTA	*Salix uva-ursi*	a-ld
	Carex bigelowii	f-a
	Hierochloe alpina	f
	Luzula confusa	f
	Vaccinium uliginosum var. *alpinum*	o-f
	Diapensia lapponica	o
	Vaccinium vitis-idaea var. *minor*	o
	Cassiope tetragona	r
	Epilobium latifolium	r
	Poa arctica	r
	Silene acaulis var. *exscapa*	r
	Arctostaphylos alpina	vr

MUSCI
Bartramia ithyphylla
Calliergon stramineum
Catoscopium nigritum
Conostomum boreale
Dicranoweisia crispula
Dicranum elongatum
D. fuscescens
Ditrichum flexicaule
Drepanocladus uncinatus
Encalypta rhabdocarpa
Plagiopus oederi
Pohlia cruda
Polytrichum norvegicum[1]
Rhacomitrium lanuginosum
Tetraplodon mnioides var. *urceolatus*
Tortella tortuosa
Tortula ruralis

HEPATICA
Chandonanthus setiformis

LICHENES
Acarospora sinopica
Buellia atrata
Caloplaca elegans
C. sorediata[1]
Candelariella placodizans
Cetraria islandica
C. nivalis a-va
Cladonia alpestris
C. alpicola
C. coccifera var. *stemmatina*
C. deformis
C. macrophyllodes
C. mitis
C. rangiferina
C. uncialis
Fulgensia bracteata
Gyrophora cylindrica var. *fimbriata*
G. proboscidea
Haematomma ventosum var. *lapponicum*
Lecidea flavocaerulescens
L. lapicida f. *ecrustacea*
L. speirea
Ochrolechia frigida
Parmelia centrifuga
P. saxatilis[1]
P. sulcata
Pertusaria dactylina
P. pertusa
Rhizocarpon badioatrum
R. disporum
R. eupetraeum
R. geographicum
R. jamtlandicum
Sphaerophorus fragilis
Sporastatia cinerea
Stereocaulon alpinum
S. arcticum
S. paschale

This already long list, which includes whole "reindeer-moss" and damp depression contingents, could be considerably extended if other similar areas were included; indeed the majority of land plants of the region are able to persist well up the hills, and probably to the highest elevations of the district, wherever suitable habitats offer.[2] As is implied by their numbers, the cryp-

[1]The record of this species for Lake Harbour was inadvertently omitted from Part II of the present series.

[2]Thus on one dry rocky ledge halfway up a cliff at an altitude of about 600 feet I chanced upon *Carex supina*, *Antennaria canescens*, and *Artemisia borealis* growing between tufts of *Saxifraga tricuspidata*, *Salix uva-ursi*, and *Poa glauca*. In a ravine just below, which is drifted over deeply with snow every winter, grew *Taraxacum lapponicum* and *Draba crassifolia*.

togams were much mixed and lacked proper dominance. *Cetraria nivalis* was the most in evidence, although several other lichens were fairly abundant; *Rhacomitrium lanuginosum* was the only moss that was at all frequent. There was hardly any humous deposition, although the mineral "soil" was in places stained brown.

As is the case also in the lowlands in places where such material is exposed at the surface (*See* below), hills of the light-coloured crystalline limestone are generally much less well vegetated than the predominantly acid-weathering summit described above. The few cryptogams exhibit only very poor growth, and phanerogams are generally limited to occasional tufts of such hardy 'barrens" species as *Dryas integrifolia, Carex nardina, Salix arctica,* and *Saxifraga oppositifolia.* A similar state of inability on the part of plant colonists to bind the surface, or sometimes an even greater degree of barrenness, is to be seen on many slopes or ridges of this crystalline material in exposed places even low down near the sea—especially where there is liable to be any movement of the coarse surface particles (*See* below).

(ii) LOWLANDS

Valleys or low plateaux occupy most of the area around Lake Harbour and comprise types of terrain that are so variable and mixed that their vegetation is extremely difficult to survey. A great range of plant communities are found, of which only a few examples will be described.

PLATE LII

Crystalline limestone terrain, mostly of *Dryas* "barrens", with closed heathy or marshy vegetation in sheltered depressions. Lake Harbour, S. Baffin, August 20, 1934.

Whereas, under favourably sheltered and damp conditions, the vegetation is rather similar whether the substratum be acid-weathering rock or crystalline limestone, the latter in exposed situations is so much less easily colonized that

its vegetation frequently remains very sparse. This is due not only to the chemical composition but also to the physical properties of the limestone, which separates into coarse crystals that afford an unstable, porous, and altogether most inhospitable surface. Plate LII shows an area of this crystalline limestone and indicates the type of country to which it characteristically gives rise—a terrain of intimate physiography with rapid, small-scale changes involving numerous small hills, ridges, and valleys. The hills and ridges are largely barren, and their sides generally support no more than a sparse open community —most often a *Dryas* "barren". This covers a great proportion of the district and, of course, varies considerably from spot to spot in composition and luxuriance, the area in the foreground of Plate LII being unusually depauperate, with plants occupying only a very small proportion of its surface. With more shelter and stability, such as is to be found on most of the lower slopes, the *Dryas* takes much more of a hold, being frequently so aided by heaths and their associates that the community becomes physiologically closed or, as the sward develops and water-retaining capacity near the surface increases, actually a continuous dwarf "heath". A 6-metre quadrat toward the base of one slope where this state was approached, and which accordingly showed many of the characteristic elements of both the *Dryas* "barrens" and the more luxuriant heath developed in sheltered depressions, had the following composition:

SPERMATOPHYTA	*Dryas integrifolia*	vad	covering half the area
	Carex rupestris	f-a	
	Cassiope tetragona	f	
	Polygonum viviparum	f	
	Salix reticulata	f	
	S. uva-ursi	f	
	Vaccinium uliginosum var. *alpinum*	f	
	Carex nardina	l	
	Epilobium latifolium	l	
	Rhododendron lapponicum	l	
	Carex misandra	o-f	
	Oxytropis maydelliana	o-f	
	Astragalus alpinus	o	
	Luzula nivalis	o	
	Papaver radicatum	o	
	Saxifraga aizoides	o	
	Silene acaulis var. *exscapa*	o	
	Luzula confusa	r	
	Poa arctica	r	
	Saxifraga oppositifolia	r	
	Tofieldia pusilla[1] (*T. borealis*)	r	
	Pedicularis lanata	vr	
	Arctostaphylos alpina	(1)	
	Carex glacialis	(1)	
	Chrysanthemum integrifolium	(1)	
	Saxifraga tricuspidata	(1)	
MUSCI[2]	*Distichium capillaceum*		
	Rhacomitrium lanuginosum		
LICHENES[2]	*Alectoria nigricans*		
	A. ochroleuca		
	Cetraria cucullata		
	C. islandica		
	C. nivalis		
	Cladonia mitis		
	Cornicularia divergens		

[1] *Tofieldia pusilla* (Michx.) Persoon, Synops. Pl.. I, p. 339, 1805 (*T. borealis* (Wahlenb.) Wahlenb.—*See* Polunin MS. 1941 and Hultén in Lunds Univ. Årsskr. N.F. Avd. 2, XXXIX, 1, p. 447, 1943).

[2] Only the most important species are listed.

	Dactylina arctica
	D ramulosa
	Gyrophora proboscidea
	Ochrolechia frigida
	Sphaerophorus globosus
	Thamnolia vermicularis
FUNGI[1]	*Cintractia caricis* on *Carex misandra* and *C. nardina*
	Puccinia bistortae on *Polygonum viviparum*

Among the mosses only *Rhacomitrium lanuginosum* was of any obvious ecological importance; but all of the above lichens were plentiful, covering between them up to nearly half the area. Uncolonized stony patches still occurred here and there in this "more than half-mat", as, for example, to the left in Plate LIII, which shows a tuft of the dominant *Dryas* in flower, surrounded by small Carices. To the right, *Cetraria nivalis* is seen above and loose squamules of *Thamnolia vermicularis* below. The "soil" was mostly composed of coarse limestone crystals interspersed with finer particles which were darkened by admixture with humus to a depth of about 7 cm. (the maximum length of the crystals), but underneath it was light grey in colour. It effervesced violently with HCl and in reaction was slightly basic—up to pH 7·2—except directly beneath the thicker and older patches of vegetation where humus predominated and neutrality apparently prevailed. Plate LIV looks down on a more luxuriant, consolidated facies, which probably represents a subclimax; it shows an abundance of *Salix reticulata* and *Vaccinium uliginosum* var. *alpinum* (tiny rounded leaves), with *Dryas* largely ousted (although still flowering well), and many lichens of good growth—especially Cetrariae and Cladoniae.

Several of the above-mentioned phanerogams, such as *Saxifraga aizoides, Carex glacialis,* and *Chrysanthemum integrifolium,* as well as some others (e.g., *Saxifraga aizoon* and *Salix calcicola*) which did not occur in the quadrat listed, appear to be confined to these calcareous areas. Nevertheless, the more luxuriant heath developed under more favourable conditions of shelter and snow-covering is much the same whether basic or acid-weathering rocks form the substratum; even the cryptogams, which include many mosses and fruticose lichens of good growth, tend ultimately to be similar. This is especially the case where humus has accumulated and so raised the surface that the reaction is neutral or slightly acid (in spite of the limestone). The chief dominant is most frequently *Vaccinium uliginosum* var. *alpinum,* the associates including *Carex bigelowii, Cassiope tetragona*[2] and *C. hypnoides, Empetrum nigrum* var. *hermaphroditum, Ledum palustre* var. *decumbens, Phyllodoce coerulea, Pyrola grandiflora, Salix* spp.,[3] and, in some places, prostrate *Betula glandulosa* var. *sibirica, Carex vaginata, Hierochloe alpina, Loiseleuria procumbens, Lycopodium annotinum* var. *alpestre,* several species of *Pedicularis,* and *Vaccinium vitis-idaea* var. *minor. Dryas* and other "barrens" types are generally absent; but the much-mixed nature of the community is indicated in Plate LV, where *Phyllodoce* is seen in flower around the centre, with the *Pyrola* above and various grasses and Carices below. Just above the 6-inch ruler is a tuft of *Cassiope hypnoides* in flower; *C. tetragona* fills the upper left-hand corner, and *Salix arctica* the upper right-hand corner, the usually dominant *Vaccinium uliginosum* var. *alpinum* being absent just here.

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[1] See footnote (2) on p. 139.

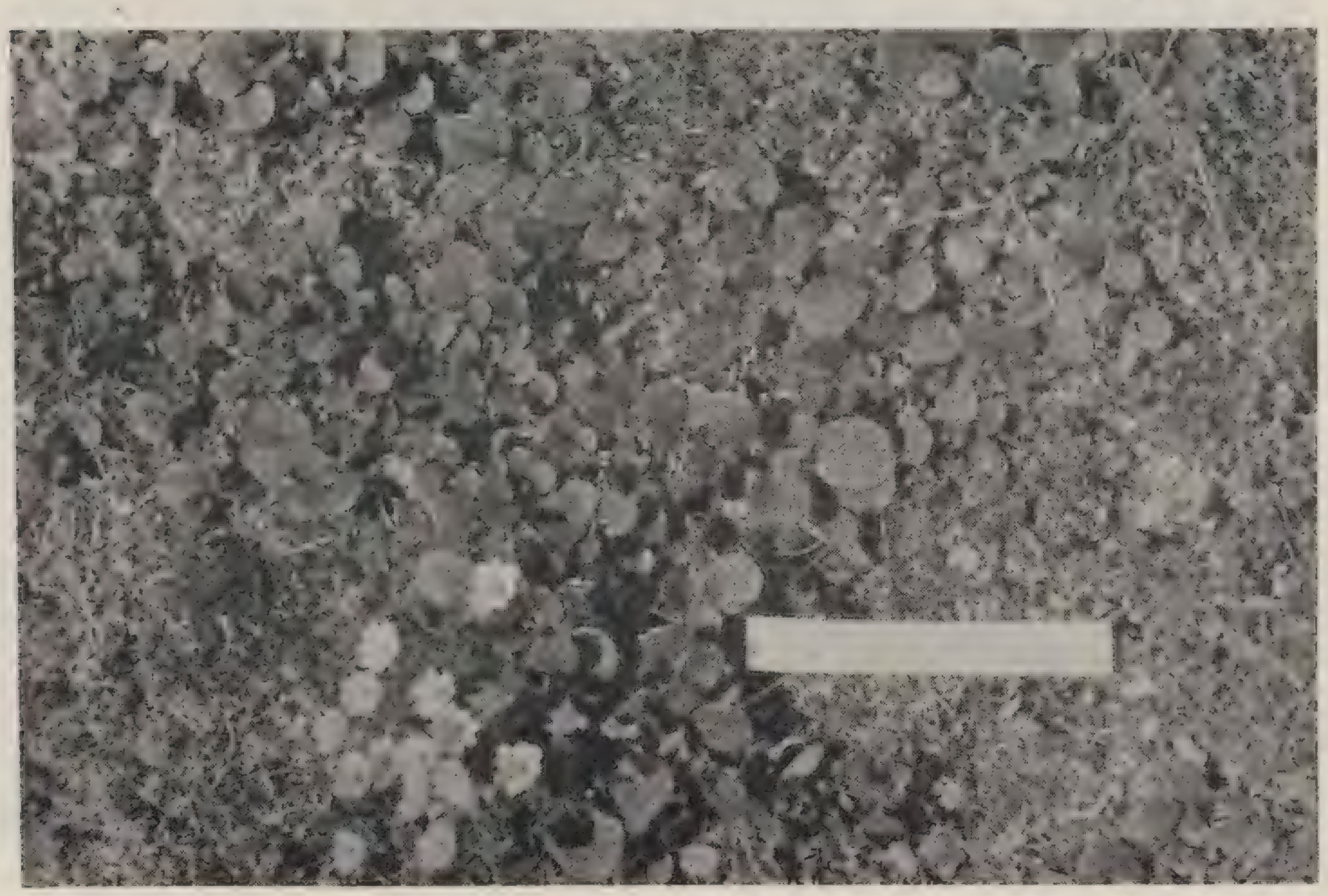
[2] Frequently parasitized by *Exobasidium vaccinii* var. *myrtilli.*

[3] Frequently parasitized by *Melampsora bigelowii.*

PLATE LIII

Dryas integrifolia in flower, surrounded by xeromorphic Carices and lichens belonging to the poor "heath" developed on sheltered slopes of crystalline limestone. The scale is a little more than 6 inches (15 cm.) long. Lake Harbour, S. Baffin, July 26, 1936.

PLATE LIV



Luxuriant, consolidated, heathy (subclimax) facies on dry gravel showing much *Salix reticulata* (large, shining leaves), *Vaccinium uliginosum* var. *alpinum* (tiny, rounded leaves), a small clump of *Dryas* in flower, and many lichens of good growth. Lake Harbour, S. Baffin, July 26, 1936.

In spite of this general convergence of the later stages of the successions on rocks of different types in favoured places, it is chiefly on acid-weathering substrata that the highest vegetation of the district is to be found. This is the *Betula-Salix* scrub developed under the most favourable combined conditions of shelter and snow-covering (but not very late melting), lasting water supply (but good drainage), and southerly aspect. It thus represents a postclimax. The dominants are *Betula glandulosa* var. *sibirica* and *Salix cordifolia* var. *callicarpaea*, and they form bushes that may spread laterally to attain a diameter of 2 m. or even 3 m., although rarely exceeding 50 cm. in height.[1]

PLATE LV

Luxuriant mixed heath with ***Cassiope hypnoides*** flowering just above the c. 6-inch (15 cm.) ruler, ***Phyllodoce*** (light-coloured, cordate "bell" flowers) around the centre, and above, ***Pyrola grandiflora*** (large, whitish flowers) in the centre, ***Salix arctica*** on the right, and, occupying the upper left-hand corner, ***Cassiope tetragona***. Lake Harbour, S. Baffin, July 26, 1936.

Far from being dense and continuous over any large area, the scrub is generally irregular and "broken" by rocks or patches of lower "heath" in the manner indicated in Plate LVI; however, the axes of the *Betula* may form a closer "tangle" in some places, and occasionally exceed their usual maximum thickness of 1 cm. Where this tangle is most dense the ground is chiefly covered with litter, and even the usually co-dominant *Salix* may be ousted. Generally, however, ground-shrubs form a subdominant layer that continues in increased luxuriance wherever the bushes are absent. The species concerned in this "heath" deck are mostly the same as those forming the luxuriant types of heath elsewhere, the chief being *Empetrum nigrum* var. *hermaphroditum*, *Phyllodoce coerulea*, *Vaccinium uliginosum* var. *alpinum*, and *V. vitis-idaea* var. *minor*. Mosses

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[1]The tallest plants I have seen in the vicinity of Lake Harbour were bushes of *Salix cordifolia* var. *callicarpaea*, which straggled to 80 cm., or of *S. calcicola*, which remained domed at a slightly lower level—cf. the closely related *S. richardsoni* var. *mckeandii* at Pond Inlet (p. 87). However, much higher specimens of *S. planifolia* occur inland (*See* p. 134, and cf. Part I of the present series, page 172).

bind this layer, which is frequently 15 cm. high, and contribute to its luxuriance, and in some dry and open spots fruticose lichens may form a dense "reindeer-moss" mat, which is, however, rarely more than 5 cm. deep. The chief crypto-

Plate LVI

Loose scrub of 40 cm. high *Betula glandulosa* var. *sibirica* (best seen on right) and *Salix cordifolia* var. *callicarpaea* (light-coloured leaves in centre and right background) on south-facing, rocky slope in sheltered situation. Lake Harbour, S. Baffin, August 31, 1934.

gams occurring in one small area, i.e., those having a frequency degree of not less than f, were as follows:

Musci	*Aulacomnium turgidum*
	Ceratodon purpureus
	Hylocomium splendens
	Pohlia nutans
	Polytrichum strictum
	Rhacomitrium lanuginosum
Hepaticae	*Chandonanthus setiformis*
	Ptilidium ciliare
Lichenes	*Cetraria crispa*
	C. islandica
	C. nivalis
	Cladonia alpestris
	C. bellidiflora
	C. coccifera var. *pleurota*
	C. cyanipes
	C. elongata
	C. rangiferina
	Dactylina arctica
	Psoroma hypnorum
	Sphaerophorus globosus
	Stereocaulon paschale
Fungi	*Chrysomyxa pyrolae* on *Pyrola grandiflora*
	Exobasidium vaccinii-uliginosi on *Vaccinium vitis-idaea* var. *minor*

Numerous other lichens (especially crustaceous species) and some mosses persisted on projecting rocks and boulders. There were also several Fungi, including, most notably, a large *Lycoperdon* (probably *L. gemmatum*)[1], and a *Boletus*[1] which in one instance was 9 cm. high and had a pileus 8 cm. in diameter. The soil was dark brown and largely of humus beneath the litter. Where tested it attained a degree of acidity as extreme as any I have found in the Canadian Arctic Archipelago, viz., pH 5·0.

Covering far more extensive areas than the last community, but less important areally than the various barrens described above, are the mixed meadow-like flats or slight slopes that probably represent the preclimax. Similar areas also occur beneath steep rocky slopes and weathering crags, where they may be influenced by solifluction and represent a mere subclimax, although this is problematical. An example is to be seen behind the R.C.M.P. detachment at Lake Harbour. The surface is generally smooth and evenly vegetated by a rather dwarf but closed community of mixed heaths, sedges, and forbs, with associated cryptogams of rather limited growth. The tallest plants are occasional specimens of such associates as *Luzula confusa* or *Hierochloe alpina,* which reach a height of 30 cm., the whole appearing yellowish green when viewed from a distance. True dominance is often lacking, as for example in the area from which the following list was made on a 5-metre quadrat:

SPERMATOPHYTA	*Dryas integrifolia*	va
	Carex rupestris	a
	Oxytropis maydelliana	a
	Salix reticulata	a
	Rhododendron lapponicum	f-a
	Vaccinium uliginosum var. *alpinum*	f-a
	Carex bigelowii	la
	C. vaginata	f
	Empetrum nigrum var. *hermaphroditum*	f
	Polygonum viviparum	f
	Hierochloe alpina	o-f
	Luzula confusa	r-f
	Pedicularis lanata	o
	Salix arctophila	r-o
	Astragalus alpinus	r
	Carex capillaris	r
	C. holostoma	r
	C. misandra	r
	Kobresia simpliciuscula	r
	Pedicularis flammea	r
	Poa arctica	r
	Carex glacialis	vr
	Silene acaulis var. *exscapa*	vr
	Tofieldia pusilla (T. borealis)	vr
	Arctostaphylos alpina	(1)
	Armeria labradorica	(1)
	Astragalus eucosmus	(1)
	Draba glabella apprg. var. *brachycarpa*	(1)
	Salix cf. *cordifolia* (young)	(1)
MUSCI	*Dicranum groenlandicum*	
	Ditrichum capillaceum	
	Distichium flexicaule	
	Hypnum bambergeri	
	Mnium orthorrhynchium	
	Myurella julacea	
	Pohlia cruda	
	Rhacomitrium lanuginosum	
	Tomenthypnum nitens	

[1] *See* footnote (1) on page 29.

LICHENES	*Cetraria cucullata*
	C. nivalis
	Cladonia mitis
	C. pyxidata var. *neglecta*
	Lecanora epibryon
	Ochrolechia upsaliensis
FUNGI	*Cintractia caricis* on *Carex glacialis, C. rupestris,* and *Kobresia simpliciuscula*
	Diplodina pedicularidis on *Pedicularis lanata*
	Puccinia bistortae on *Polygonum viviparum*
	P. drabae on *Draba glabella*
	Rhytisma salicinum on *Salix* cf. *cordifolia*
	Russula ochroleuca

The above *evident* parasitic Fungi, listed at the end of August, are unusually numerous for such a small area of arctic terrain.

In spite of some general similarity between the above lists and the one given previously from a colonized limestone slope, the areas are entirely different in the two cases, being in the present instance apparently of morainic origin, although there is little or no admixture of calcareous material. The surface 5 cm. are dark brown and largely of humus, being thereafter lighter in colour and gravelly to a depth of at least 30 cm. Among the cryptogams, only the yellowish *Cetraria nivalis* is much in evidence. The most characteristic facies are hollows where snow drifts deeply in winter and dark *Cassiope tetragona* enters in place of the light-coloured *Cetraria nivalis,* and marshy depressions where sedges and grasses predominate to the relative detriment of heaths.

PLATE LVII

Luxuriant marsh dominated by *Arctagrostis* (in foreground) and *Eriophorum* spp., with water standing in many places. On the dry limestone slope behind, the vegetation thins out until the exposed prominences are almost barren. Lake Harbour, S. Baffin, Aug. 30, 1934.

(iii) MARSHES

These occupy many flats and low-lying, poorly drained, slight slopes around Lake Harbour, being especially extensive some miles inland of the 'post'. The composition and luxuriance vary considerably from place to place, and so does the conformation of the surface, which may be rendered very uneven by muddy depressions or numerous hillocks (cf. p. 84). Two of the main types are seen in Plates LVII and LVIII, the former being of a luxuriant marsh with standing water in many places, and the latter of a drier, "hillock tundra" area whose composition on the tussocks approaches that of the heathy meadow described above, and which may accordingly indicate some tendency toward a general regional climax.

PLATE LVIII

Extensive "hillock tundra" marsh on undulating plains inland of Lake Harbour, S. Baffin, July 27, 1936.

A typical lakeside marsh being described in general terms below, from Dorset, in the same major district, it will be sufficient here merely to give a list in alphabetical order of the most typical marsh dominants (marked *) and phanerogamic associates in the vicinity of Lake Harbour:

**Arctagrostis latifolia*
Cardamine pratensis var. *angustifolia*
Carex aquatilis var. *stans* (forma apprg. *C. bigelowii*)
C. atrofusca
C. bipartita
C. gynocrates
C. norvegica[1] (*C. halleri*)
**C. membranacea*
C. misandra

[1] *Carex norvegica* Retz., Fl. Scand. Prodr. ed. 1, p. 179, 1779 (*non* Willd., 1801) (*C. halleri* Gunn.—*See* Fernald in Rhodora, XLIV, p. 304, 1942; Hultén in Lunds Univ. Årsskr. N.F. Avd. 2, XXXVIII, 1, p. 348, 1942; Porsild in Sargentia, IV, p. 20, 1943).

C. rariflora
C. saxatilis var. *miliaris*
C. vaginata
Dupontia fisheri (incl. var. *aristata*)
**Eriophorum angustifolium* (up to 45 cm. in height)
**E. callitrix*[1]
Juncus albescens
J. arcticus
J. biglumis
J. castaneus
Luzula nivalis
Pedicularis flammea
Poa arctica
Polygonum viviparum
Ranunculus lapponicus
Salix arctica
S. arctophila
S. herbacea
Saxifraga aizoides
S. hirculus
**Scirpus caespitosus* var. *callosus*
Tofieldia pusilla (*T. borealis*)

Among cryptogams, *Equisetum arvense* and *E. variegatum* are generally present, and mosses, including such tussock-forming species as *Sphagnum plumulosum*, largely "fill in" the surface. The dominants and chief associates are generally much the same, whether the underlying rock is of limestone or dark, acid-weathering material; however, this is not the case with some of the less important associates, which may be largely or entirely limited to one or the other substratum; another 'complication' is that drier facies, including the tops of the tussocks in "hillock tundra," have heath associates or even dominants, whereas wetter facies belong rather to the freshwater communities described below. The reaction is generally neutral or slightly basic (pH 7·2) on the limestone and, wherever tested, not markedly acid even in marshes overlying the dark acidic rocks.

(iv) SNOW EFFECT

The snowfall being considerable at Lake Harbour and the physiography very variable, the snow in winter drifts so deeply in many hollows that the growing-season is much reduced by its late disappearance every summer. In the warm days which may occur here as early as the middle of May, the snow melts rapidly, so that by the middle of June it has largely gone, and by the middle of July almost all even of the deepest drifts have disappeared, with the consequence that extremely "late-snow" inner zones and centres (of the more or less barren types that have been described above from most places to the north) are rather rare around Lake Harbour. Indeed, the centre of these snow patches is generally occupied by a relatively luxuriant herb "barren" or even "half-barren" or a mixed and mossy mat, which is succeeded by a narrow zone dominated by dwarf Salices and then a broad one of dark *Cassiope tetragona*. This is well seen in Plate LIX, which shows the inner zone in the foreground, at the bottom of the depression, and *Cassiope* heath to the left of the Eskimo, where the snow melts earlier and drainage is better. Behind, on the more exposed side of the ridge where there is little snow-covering in winter, the *Cassiope* rapidly gives way to a poorer, discontinuous heathy community of the type listed on pages 139-140, and ultimately to the *Dryas* "barrens" with much light-coloured *Cetraria nivalis* seen on the top of the ridge.

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[1] Contrary to the implication of Fernald (1925, p. 205), this species is locally much more plentiful than *E. spissum*.

A 4-metre quadrat of the *Cassiope* zone developed on one area of crystalline limestone, where the dominant was 7-12 cm. high and covered almost half the area, gave the following list:

VASCULARES	*Cassiope tetragona*	vad
	Salix reticulata	f-a
	Dryas integrifolia	la
	Carex misandra	f
	C. scirpoidea	f
	Luzula nivalis	f
	Astragalus alpinus	o
	Epilobium latifolium	o
	Oxyria digyna	o
	Polygonum viviparum	o
	Saxifraga aizoides	o
	Equisetum variegatum	r-o
	Kobresia simpliciuscula	r
	Oxytropis maydelliana	r
	Pedicularis flammea	r
	Pyrola grandiflora	r
	Saxifraga oppositifolia	r
	Tofieldia pusilla (T. borealis)	r
	Vaccinium uliginosum var. *alpinum*	r
	Poa alpina	vr
	Silene acaulis var. *exscapa*	vr
	Astragalus eucosmus	(1)
	Pedicularis lanata	(1)
	Salix cordifolia var. *callicarpaea*	(1) 20 cm. high
	Stellaria longipes	(1)
MUSCI[1]	*Camptothecium lutescens*	
	Dicranoweisia crispula	
	Distichium capillaceum	
	Hylocomium splendens	
	Hypnum revolutum[2]	
	Kiaeria blyttii	
	Tomenthypnum nitens	
	Tortella tortuosa	
LICHENES[1]	*Cetraria crispa*	
	C. cucullata	
	C. islandica	
	Cladonia coccifera var.	
	C. elongata	
	C. mitis	
	C. pyxidata var. *pocillum* and var. *chlorophaea*	
	Dactylina arctica	
	D. ramulosa	
	Stereocaulon alpinum	
FUNGI	*Chrysomyxa pyrolae* on *Pyrola grandiflora*	
	Calvatia fragilis	
	Clitocybe fritilliformis	

The soil just at the surface was dark and humous, though generally neutral in reaction. Mosses and lichens, of which only the chief species are listed above, were much mixed and about equally important, largely covering the areas between the *Cassiope tetragona* tufts. These intervening areas tended to be rather better vegetated on acid-weathering rocks, as is seen in Plate LX, which shows the *Cassiope tetragona* in flower and between its tufts a closed grassy-sedgy mat with much *Cassiope hypnoides*.

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[1] Only the more important species are listed.

[2] The record of this species from Lake Harbour was inadvertently omitted from Part II, p. 473.

PLATE LIX

"Snow-patch" on area of crystalline limestone. In the foreground, at the bottom of the depression, is the herbaceous "half-barren" zone, followed by dark *Cassiope* (on bank, to left of Eskimo). On top of the ridge are *Dryas* "barrens" with much light-coloured *Cetraria nivalis,* indicating a lack of snow-covering just there. Lake Harbour, S. Baffin, August 31, 1934.

PLATE LX

Cassiope tetragona zone of "snow-patch" on area of quartz monzonite. The *Cassiope* is flowering profusely and the tracts between its tufts support many grasses and sedges. Lake Harbour, S. Baffin, July 27, 1936.

Two small areas of the rather sedgy, herbaceous "half-barren" zone developed on crystalline limestone inside *Cassiope* heath of the type listed above, were found to support the following angiosperms:

Oxyria digyna	f-la
Polygonum viviparum	f
Erigeron unalaschkensis	absent-f
Cerastium alpinum	o
Lychnis apetala	o
Eutrema edwardsii	r-o
Poa alpina	r-o
Chrysanthemum integrifolium	absent-o
Salix herbacea[1]	absent-o
Arenaria sajanensis	
Braya purpurascens	
Carex misandra	
C. scirpoidea	
Epilobium latifolium	
Parnassia kotzebuei	
Saxifraga aizoides	
S. cernua	
S. oppositifolia	
Trisetum spicatum var. *maidenii*	

(v) SPECIAL LOCALIZED HABITATS AND COMMUNITIES

The area at Lake Harbour that has been disturbed by man is very small, but nevertheless interesting—especially the calcareous gravel around the Hudson's Bay Company's trading post, which is colonized by the following herbs, including several that appear to be absent from surrounding areas. The community remained open when I last visited it in late August, 1936, and in the virtual absence of competition (though probably not of manuring) the growth of almost all species was unusually luxuriant, some axes of *Arabis alpina* attaining the remarkable length of 35 cm.

Arabis alpina
A. arenicola
Arenaria rubella
A. uliginosa
Braya purpurascens
Carex glacialis
C. maritima
Cerastium alpinum[2]
Draba glabella and var. *brachycarpa*
D. fladnizensis[3]
D. norvegica var. *hebecarpa*
Lesquerella arctica
Lychnis furcata
Phippsia (*Catabrosa*) *algida*
Poa glauca and var. *tenuior*
P. pratensis s.l.
Puccinellia angustata
Ranunculus pedatifidus var. *leiocarpus*[4]
Sagina intermedia
Saxifraga tricuspidata
Stellaria longipes
Taraxacum lacerum
Trisetum spicatum var. *maidenii*

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[1] Not infrequently parasitized by *Melampsora bigelowii* and *Venturia ditricha*.

[2] Parasitized by *Peronospora tornensis*.

[3] Parasitized by *Pseudopeziza drabae*.

[4] Parasitized by *Puccinia ranunculi*.

Around Lake Harbour are developed, to a degree unrecorded elsewhere in our area, "flower slopes" of the type that is occasionally seen inland in Spitsbergen (Polunin MS. 1933) or more often in Novaya Zemlya (cf. Lynge 1934, photo facing p. 133).[1] These are sunny, south-facing slopes where an unusually favourable combination of shelter, aspect, water, aeration, mixed (preferably friable) substratum, and other factors results in the appearance of such a mass of more or less rank herbs that the usual heathy or other dominants are unable to take a hold. Most frequently such flowery slopes, which are generally rather steep, are developed below cliffs or weathering crags, where it may be that instability of the surface of the "slide" is chiefly instrumental in maintaining the herbaceous dominance: whether or not this is the case, the community is a highly characteristic one. That it lacks true dominance and is variable from place to place is to be expected, but the intricate mixing of so many species of good growth, most of them forbs with attractive flowers, is almost unparalleled even in the Arctic where nanism is the rule. Plate LXI shows a typical spot at the top of such a flowery slope, where the surface may occasionally be disturbed by falling splinters of rock. It was taken in late July when most of the species were in full bloom—e.g., *Saxifraga tricuspidata* on the right and *Papaver* and *Epilobium latifolium* on the left. In the centre is much

Plate LXI

Top of "flower slope" below weathering crag festooned with *Saxifraga oppositifolia.* On right is seen *Saxifraga tricuspidata*, on left *Epilobium latifolium* and *Papaver radicatum.* In the centre is *Erigeron eriocephalus* and, just in front of the sheath-knife, *E. unalaschkensis.* Lake Harbour, S. Baffin, July 28, 1936.

[1] The superficially rather similar slopes that I have noted as occupying many areas at high altitudes in Labrador (1931 field notes), south Greenland (1937 field notes), Iceland (MS. 1938), and northern Lapland (1930 and 1933 field notes), appear to belong rather to the normal alpine series of communities that are developed on high mountains in more southern latitudes. Frequently they are of a "spring flush" type (cf. Leach and Polunin 1932, p. 417).

tall *Erigeron eriocephalus* of the "tousled" heads and, just in front of the sheath-knife, *E. unalaschkensis.*[1] Festooning the rocks behind are long "tassels" of *Saxifraga oppositifolia.* Plate LXII shows an area farther down where the herbs are consolidated into a continuous mat—just here predominantly of *Stellaria longipes* and *Taraxacum lacerum,* both of which are flowering profusely.

PLATE LXII

Stellaria longipes and *Taraxacum lacerum* (dark, left) on closed "flower slope". The ruler is a little more than 6 inches (15 cm.) long. Lake Harbour, S. Baffin, July 28, 1936.

Two 4-metre quadrats of such a "flower slope", where the substratum was of acid-weathering scree and the altitude 360-400 feet (110-122 m.), gave the following considerable combined list of species, almost all of which occurred in plenty and are to be seen flowering abundantly about the end of July:

[2]*Antennaria angustata*
[2]*A. canescens*
[2]*A. labradorica*
Arenaria rubella
[3]*A. sajanensis*
Arnica alpina var. *angustifolia*
Artemisia borealis var. *purshii*
Astragalus alpinus
Campanula uniflora
[3]*Cardamine bellidifolia*
Carex bigelowii
C. rupestris
Draba glabella
D. nivalis
Epilobium latifolium

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[1] These two species of *Erigeron* have very different habitat preferences and are not often to be seen growing together—*See* Part I of the present series, pp. 343-6.
[2] Still only in bud on July 28, 1936, but already over toward the end of August in both 1934 and 1936.
[3] Flowers over by July 28 on this slope in 1936; all species not so marked were either flowering or still in bud at this time those in bud being marked [2].

Erigeron eriocephalus
E. unalaschkensis
Festuca brachyphylla
Hierochloe alpina
Luzula spicata
Lychnis furcata
Oxyria digyna
Oxytropis maydelliana
Papaver radicatum
[1]*Pedicularis hirsuta*
[2]*P. lapponica*
Polygonum viviparum
[1]*Potentilla hyparctica* var. *elatior*[3] *(P. emarginata)*
P. nivea
[2]*Pyrola grandiflora*
[1]*Salix herbacea*
[1]*S. uva-ursi*
Saxifraga nivalis
S. tricuspidata
Silene acaulis var. *exscapa*
Stellaria longipes
Taraxacum lacerum
Trisetum spicatum var. *maidenii*
[2]*Vaccinium vitis-idaea* var. *minor*

Although *Woodsia glabella* and *Cystopteris fragilis* were to be found, mosses and lichens were few and of poor growth, in most places leaving the coarse scree particles uncolonized between the roots of the higher plants. The rock above was in most places retentive of some moisture and of its own surface, so that various chasmophytic and other limited communities were able to exist on it. Plate LXIII shows a typical area with crustaceous lichens clothing the surface, *Cassiope tetragona* (in flower) growing on ledges, and a fine flowering tuft of *Saxifraga cernua* rooting in a slight crevice. A ledge of crystalline limestone in another area is seen in Plate LXIV; its dry, crumbling surface supports *Cetraria nivalis* and other large lichens, and some dwarfed but flowering plants of *Saxifraga aizoon*.

(vi) FRESHWATER

As is the case with lakes and ponds (*See* below), the vegetation of running streams is very variable, changing from one example to another in accordance with obvious changes of the environment, and often differing entirely for no apparent reason from one point to the next in the selfsame stream. Very frequently the bed is darkened by long brown tassels of aquatic mosses, or supports in slow eddies (especially where the substratum is of mud) such phanerogams as *Hippuris vulgaris, Colpodium fulvum* var. *effusum, Ranunculus trichophyllus* var. *eradicatus, R. hyperboreus,* or tiny *Eleocharis acicularis* f. *submersa.* The associated Algae, which may also in most cases grow on stones or patches of mud even where higher vegetation is absent, are also very mixed and variable. The following (exclusive of Diatomeae) were present in a total of five samples taken from two different streams in late July or late August, 1936:

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[1] See footnote (3) on p. 152.
[2] See footnote (2) on p. 152.
[3] *Potentilla hyparctica* var. *elatior* (Abrom.) Fernald in Rhodora, XLV, p. 111, 1943 (*P. emarginata* Pursh—*See* Fernald *l.c.*).

Aphanocapsa elachista
A. pulchra
**Aphanothece saxicola*
Bulbochaete basispora
Calothrix fusca
**C. parietina*
C. pulvinata[1]
Chamaesiphon incrustans
Closterium dianae
C. venus
**Cosmarium botrytis*
**C. holmiense* var. *integrum*
Dichothrix compacta
D. gypsophila
Dinobryon sertularia
Gloeocapsa rupicola
**Hyalotheca dissiliens*
Merismopedia glauca
Microcystis elabens var. *minor*
**Rivularia minutula* var. ?
Schizothrix vaginata
Staurastrum aculeatum
S. baffinensis
S. bieneanum
S. cyrtocerum
S. hexacerum
S. inconstans
S. meriani
S. mucronatum
S. muticum
Stigonema informe
S. mamillosum
Tetmemorus laevis
Tolypothrix distorta var. *penicillata*
Ulothrix tenerrima

Of these thirty-five species, only the six marked "*" occurred in two samples and none was found in as many as three samples, which indicates the extreme local variability and probable great range of the algal flora—especially when we recall that the diatoms have not been included in this list.

Interesting in this connection is the algal investment of seepage areas on rocky cliffs, two samples yielding the following species:

Aphanocapsa grevillea
A. pulchra
Calothrix parietina
Chroococcus turgidus
Cosmarium parvulum
C. plicatum
C. subcrenatum
Euastrum elegans
Gloeocapsa ralfsiana
Microcystis pulverea
Nostoc sphaericum
Phormidium retzii
Plectonema tomasinianum var. *gracile*
Rivularia compacta
Staurastrum clepsydra var. *sibiricum*
S. gratum
S. meriani
Stigonema minutum
Tetmemorus laevis
Tolypothrix limbata
Trentepohlia iolithus

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[1] The record of this species from Lake Harbour was inadvertently omitted from Part II, p. 42.

PLATE LXIII

Gneissic crag overhanging "flower slope", showing *Cassiope tetragona* (in flower) above and *Saxifraga cernua* in crevice below. The rock surface is largely covered by crustaceous lichens of good growth. Lake Harbour, S. Baffin, July 28, 1936.

PLATE LXIV

Disintegrating rocky ledge of crystalline limestone supporting *Cetraria nivalis* and other lichens, and dwarfed *Saxifraga aizoon* in flower. Lake Harbour, S. Baffin, Aug. 27, 1936.

Of these twenty-one species only *Cosmarium subcrenatum* (Desmidiaceae) and the cyanophycean *Microcystis pulverea* occur in both samples, whose dissimilarity may, however, be due in part to the fact that one was taken from an area of crystalline limestone and the other from a cliff of acid-weathering rock. It is also notable that only four of the above species were identified from the nearby streams. Nevertheless, it seems that, when the next two lists of Algae are added to the ones given above, we have a fair idea of the freshwater algal flora of the district.

The communities of standing bodies of fresh water and their margins are also extremely variable. Thus the margins of lakes in exposed situations, especially where they are rocky and wave-washed, are often virtually barren, whereas in sheltered and muddy places a luxuriant marsh is the rule. All intermediate stages and gradations occur, an interesting example being the puddly swamps composed of such plants as *Eriophorum angustifolium* (often growing out into fairly deep water), *Colpodium fulvum* var. *effusum*, *Equisetum arvense*, *E. variegatum*, *Juncus arcticus*, *J. albescens*, *Carex membranacea*, *C. atrofusca*, *C. saxatilis* var. *miliaris*, *Dupontia fisheri*, and *Arctagrostis latifolia*. Also characteristic of the less well vegetated lakesides are *Carex rariflora*, *Eriophorum callitrix*, *Salix arctophila*, *Tofieldia pusilla* (*T. borealis*), and many other marsh species where such mosses as *Drepanocladus sendtneri* and *Orthothecium chryseum* partly consolidate the surface; and, in the open muddy areas that are inundated for some time after snow-melt, the smaller Junci, *Deschampsia pumila*, *Eleocharis acicularis* f. *submersa*, *Ranunculus pallasii*,[1] *Arenaria uliginosa*, *Carex bicolor*,[2] and *C. chordorrhiza*. The last mentioned plant, hitherto unknown from the Arctic Archipelago, was found in 1936 to be quite plentiful a few miles inland of Lake Harbour, growing in its characteristic tarnside habitat, with conspicuous long stolons creeping over the surface of wet mud and sometimes extending for a foot or two out over the water (*See* Part I, pp. 112-3).

The following Algae were identified from two small samples of "green slime and dark-brown bubbles" formed on mud and taken in late July, 1936, from the bottom of one large lake near its margin:

**Achnanthes flexella*
**A. minutissima* var. *cryptocephala*
Caloneis silicula var. *alpina*
Chroococcus turgidus
Cosmarium bioculatum var. *hians*
**C. botrytis*
**C. granatum*
**C. holmiense*
C. sexangulare f. *minimum*
**C. subcrenatum*
C. subtumidum
**Cyclotella antiqua*
Cymbella amphicephala
**C. angustata* var. *hybrida*
C. botellus
**C. cesatii*
**C. cistula* var. *maculata*
**C. scotica* var. *incerta*
C. tumidula
**C. turgida*
**C. ventricosa* var. *genuina*
**Denticula tenuis* var. *intermedia*
Diatoma tenue var. *pachycephalum*

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[1] Only found once (*See* Part I, pp. 210-1), but probably more important inland.

[2] This interesting species has recently been found in Britain, and in very similar habitats—cf. Harrison (1941, p. 112) and Polunin (1941, p. 159), and *See* also below, pp. 174, 260, 278.

* For explanation see next page.

Dinobryon sertularia
Epithemia cistula
Euastrum pectinatum
E. pectinatum var. brachylobum
Fragilaria pinnata
Glenodinium dybowskii
Gomphonema angustatum var. undulatum
Meridion circulare
Merismopedia tenuissima
Navicula bacilliformis
N. radiosa var. genuina and var. tenella
N. sphaerophora
N. tuscula
N. vulpina
N. zellensis var. linearis
Nitzschia angustata
N. denticula
N. frustulum
N. gracilis
N. palea
N. sinuata
Nostoc minutum
Pinnularia viridis var. intermedia
Staurastrum brachycerum
S. brevispinum
S. furcigerum
S. gracile
Stauroneis anceps var. amphicephala
Synedra amphicephala
S. ulna var. recta
Tabellaria fenestrata
T. flocculosa
Tolypothrix distorta var. penicillata
T. lanata
T. tenuis

Algae were even more numerous in small shallow pools about this time—especially desmids in peaty tundra puddles. In one or more of six samples taken from such habitats in late July or late August, 1936, entities marked " * " in the above list occurred, and, in addition, all of the following:

Amphora ovalis var. typica
Ankistrodesmus falcatus
Aphanocapsa grevillea
A. muscicola
A. roeseana
Aphanothece castagnei
A. saxicola
Arthrodesmus bifidus
A. octocornis
Bulbochaete intermedia
Caloneis islandica
C. obtusa
Chroococcus limneticus
Closterium dianae var. arcuatum
C. jenneri and var. robustum
C. kuetzingii
C. parvulum
C. striolatum
C. toxon
C. venus
Cosmarium angulosum
C. blyttii
C. conspersum var. latum

C. costatum
C. cucumis
C. cucurbitinum
C. furcatospermum
C. holmiense var. *integrum*
C. humile and var. *glabrum*
C. inconspicuum
C. isthmium
C. meneghinii
C. phaseolus
C. plicatum
C. polygonum
C. praemorsum
C. pseudopyramidatum
C. punctulatum
C. pycnochondrum
C. ralfsii
C. speciosum var. *simplex*
C. subquadratum
C. turpinii
C. undulatum
Cyclotella stelligera
Cymbella aequalis
C. angustata var. *linearis*
C. austriaca
C. cistula var. *eucistula*
C. heteropleura var. *minor*
C. scotica var. *naviculacea*
C. turgidula
Dichothrix gypsophila
D. horsfordii
Diploneis oblongella var. *ovalis*
D. pseudovalis
Epithemia argus
Euastrum ansatum
E. bidentatum
E. binale
E. didelta
E. dubium
E. elegans
E. gemmatum
E. pinnatum
E. turneri
E. verrucosum
Eunotia exigua
E. parallela
E. praerupta var. *genuina*
Fragilaria brevistriata
F. construens
Frustulia rhomboides var. *crassinervia*
Glenodinium neglectum
Gloeocapsa compacta
G. decorticans
G. punctata
G. rupicola
Gloeocystis gigas
Gloeothece palea
Gonium pectorale
Hyalotheca dissiliens
Melosira granulata
Merismopedia glauca
M. punctata
Microcoleus vaginatus
Microcystis elabens
M. pulverea

Navicula bacillum
N. minima var. *atomoides* and var. *typica*
N. pupula
N. rotaeana
N. variabilis var. *capitata* and var. *gomphonemacea*
N. viridula var. *genuina*
N. zellensis var. *typica*
Neidium affine var. *capitatum*
N. bisulcatum
N. incurvum
N. iridis var. *ampliatum*
Nitzschia amphibia
N. amphioxys
N. apiculata
N. subtilis var. *paleacea*
Nostoc aureum
N. commune
N. linckia
Ophiocytium parvulum
Penium spirostriolatum
Peridinium cinctum
Pinnularia biceps f. *petersenii* and f. *stauroneiformis*
P. cleveana
P. divergens var. *sublinearis*
P. fasciata var. *inflata*
P. globiceps var. *krookii*
P. major var. *subacuta*
P. mesolepta var. *stauroneiformis*
P. spitsbergensis
P. viridis var. *commutata*
Pleurotaenium ehrenbergii
P. trabecula
Rhopalodia gibba
Rivularia minutula
Scenedesmus bernardii
Schizothrix fuscescens
Spondylosium planum
Staurastrum avicula
S. bicorne
S. bieneanum
S. dejectum var. *inflatum*
S. dickiei
S. furcatum
S. granulosum
S. hexacerum
S. johnsonii
S. meriani
S. muticum
S. natator
S. pachyrhynchum
S. polymorphum
S. polytrichum
S. proboscidium
S. punctulatum
S. teliferum
S. tetracerum
S. tohopekaligense var. *trifurcatum*
Stauroneis anceps var. *siberica*
S. phoenicenteron var. *amphilepta* and var. *genuina*
Tolypothrix tenuis
Xanthidium cristatum

(vii) SEASHORE

The marine plant communities around Lake Harbour have unfortunately not been investigated, but between tide-marks Fuci (principally *F. vesiculosus*, but there is also some *F. evanescens*) form luxuriant mats between and on the sides of sheltering rocks or boulders. This growth is most luxuriant down near low tide-mark, and becomes poorer and poorer as the upper limit of the very considerable tidal range is approached. Many of the shores are of inhospitable smooth rock or shifting mud or sand, so the associated Algae appear to be rather few. Indeed in some places where Fuci are absent there is little to be found except, in pools, the usual *Pylaiella littoralis* and *Ralfsia verrucosa*. The former may be especially plentiful, forming a greenish "felt", where streams of water (which may be largely fresh at times) are left by the receding tide; here also are to be found *Chaetomorpha tortuosa*, *Enteromorpha micrococca*, *Ulothrix flacca*, and many diatoms—also (presumably washed down) occasional desmids such as *Euastrum elegans*, which occurs in freshwater habitats in the vicinity (cf. lists on pp. 154 and 158).

In the small and shelving, sandy or muddy bays between the barren rocks that usually form the seaboard, a dense "saltmarsh" sward of *Puccinellia phryganodes* is typically developed. Around high tide-mark this is usually almost pure, but higher up, in the region reached only by spring tides, the following associates are to be found, the species varying locally according to the particular conditions:

Carex bipartita var. *amphigena*[1]
C. maritima
C. ursina
Cochlearia officinalis vars.
Koenigia islandica
Montia lamprosperma
Phippsia (Catabrosa) algida
Potentilla egedii
Puccinellia paupercula
Stellaria crassifolia
S. humifusa

Plate LXV shows a corner of such a saltmarsh cove whose rocky sides are of crystalline limestone (a lone bush of *Salix calcicola* is seen near the upper left-hand corner). The sandy floor is clothed by a dense mat of *Puccinellia phryganodes*, which is green below, on the right where the water frequently reaches, but above is of a characteristic reddish hue. Plate LXVI is a "close-up" of part of the sward near high spring tide-mark, where *Potentilla egedii* is co-dominant with the *Puccinellia*, whose long stolons ramify and sprout in all directions to form a dense, tangled mat. This was the first discovery of *Potentilla egedii* in the American Arctic Archipelago, but it was found again the following year in Frobisher Bay (cf. Polunin 1939, p. 40).

Plant Communities Around (Cape) Dorset

Cape Dorset (latitude 64° 10′ N., longitude 76° 30′ W.) is situated on Dorset Island, one of a group of five islands that until recently were thought to form part of the mainland of Foxe Peninsula, but that are now known to be tied together merely by bars which are generally covered at high tide. That fairly recent years have seen an uplift in this region is evidenced by the drying up of some of these bars. The Hudson's Bay Company's trading post, in the vicinity

[1] Also, very rarely, var. *glareosa*.

PLATE LXV

Diminutive "saltmarsh" dominated by tangled *Puccinellia phryganodes* at side of sheltered bay. The rock behind is crystalline limestone. On it is seen, on the left, a bush of *Salix calcicola* and below this, in the angle between cliff and saltmarsh, is a tall tuft of *Juncus arcticus*. Lake Harbour, S. Baffin, Aug. 27, 1936.

PLATE LXVI

Looking down on the same saltmarsh, where *Potentilla egedii* (in flower) is locally co-dominant with *Puccinellia phryganodes* (long, light-coloured stolons). Lake Harbour, S. Baffin, Aug. 27, 1936.

of which all the following observations were made, is situated in a small harbour on the north side of Dorset Island. The country thereabouts is characterized by rather long, dark hills with a directional trend approximately northwest and southeast. Although in a few places the terrain is more bold and rugged, and locally even imposing, the contours are usually smoothed by glacial action, the summits being rounded and of the order of 800 feet (244 m.) in altitude. The valleys between the hills are low and often broad and open, with numerous shallow tarns.

The fundamental rocks are dark granites and gneisses, which in many places give a reddish brown coloration on weathering, due to contained iron. There are also some narrow bands of crystalline limestone (or perhaps sometimes quartz monzonite) that outcrop to give a whitish grey aspect to the scene quite locally. In the lowlands are numerous raised marine beaches of the usual rewashed glacial material, and "beach ridges" of loose cobble-stones that to this day may remain practically unvegetated except by very low forms of plant life.

Although no precise data are yet at hand, Dorset appears to be an unusually cold and "late" place.[1] It is said that the temperature is usually at least 10°F. (5·5°C.) lower than at Lake Harbour (frequently 15°F. lower in late winter), and in this connection it may be noted that the monthly means are generally at least 3 to 5°F. lower at Nottingham Island, not so far to the south of Dorset, than at Lake Harbour during the corresponding period (Anon. 1931 onwards). In these regions where many of the larger plants are barely able to live, this is already a very significant difference, and it may afford the chief explanation of why the vegetation around Dorset is in general so much poorer and less variable than around Lake Harbour. Indeed, so poorly developed is the vegetation in most areas that, as at Clyde, one gets the impression that the land has only recently been laid bare for colonization by terrestrial plants. The whole phenomenon may in large part be due to the exposed situation near the open sea.

(i) HILL SUMMITS AND SLOPES

The hills both large and small are for the most part very poorly vegetated, owing their dark colour to the hue of the rock and the growth of lichens. The summits are flat or gently domed by glacial action and subsequent erosion, and tend to extreme barrenness, especially where rocky. However, the rock surface almost always supports numerous crustaceous and other small lichens, and in crevices or pockets where comminuted material can accumulate there are usually to be found a few higher plants. The following angiosperms were listed on a summit 800 feet (244 m.) high, in an area of about 30 square metres, that included a rocky but damp depression to which some of the species were confined:

Luzula confusa	lf
Hierochloe alpina	r
Cardamine bellidifolia	vr
Cassiope tetragona	vr
Draba nivalis	vr
Empetrum nigrum var. *hermaphroditum*	vr
Salix herbacea	vr
Cerastium alpinum	(2)
Festuca brachyphylla	(2)
Luzula nivalis	(1)

The sides of the hills are most often either smooth and gently sloping (*See* Plate LXVII), or of broken cliffs (as in Plate LXVIII). The former type generally shows a gradual amelioration in the vegetation as the valley is approached;

[1] Thus in both 1934 and 1936, a number of plants unusual for the latitude were still in flower near sea-level during the last days of August—cf. Plate LXIX.

PLATE LXVII

Typical lowlands, with broken rocks in foreground colonized only by lichens, and vegetation rarely closed even around the lakes. Low, 'desert' hills are seen on the far side of the valley, and behind are taller ones obscured by cloud. Dorset, S. Baffin, Aug. 29, 1934.

PLATE LXVIII

Barren rocky terrain in foreground and hill in distance. Between lie gravelly terraces, which are darkened by *Cassiope* in sheltered depressions that are filled with snow in winter. Dorset, S. Baffin, Aug. 25, 1936.

PLATE LXIX

Saxifraga tricuspidata (left) and *Epilobium latifolium* (right) flowering late on a small north-facing scree. The scale is a little more than 6 inches (15 cm.) long. Dorset, S. Baffin, Aug. 25, 1936.

the latter affords a roothold on ledges and patches of soil or scree (Plate LXIX), and shelter in crevices and behind blocks of rock, for a varying population of plants, of which the following more typical members were met during at least two of my three ascents made in the vicinity:

VASCULARES	*Arenaria sajanensis*
	Cardamine bellidifolia
	Cerastium alpinum
	Draba fladnizensis
	D. nivalis
	Epilobium latifolium
	Eutrema edwardsii
	Festuca baffinensis
	F. brachyphylla
	Hierochloe alpina
	Luzula confusa
	Lycopodium selago
	Oxyria digyna
	Poa arctica
	P. glauca
	Potentilla hyparctica var. *elatior* (*P. emarginata*)
	Ranunculus nivalis
	Sagina caespitosa
	Saxifraga caespitosa
	S. cernua and f. *latibracteata*
	S. rivularis
	S. tricuspidata
MUSCI	*Ceratodon purpureus*
	Leptobryum pyriforme
	Polytrichum piliferum
	Rhacomitrium lanuginosum

HEPATICAE	*Chandonanthus setiformis* *Gymnomitrium corallioides* *Scapania undulata*
LICHENES[1]	*Alectoria nigricans* *Cetraria delisei* *C. islandica* *C. nigricans* *C. nivalis* *Cladonia bellidiflora* *C. coccifera* var. *stemmatina* *C. lepidota* f. *stricta* *C. mitis* *C. pyxidata* var. *chlorophaea* *C. uncialis* *Dactylina arctica* *Gyrophora cylindrica* var. *delisei* and var. *fimbriata* *Ochrolechia frigida* *Pertusaria oculata* *Sphaerophorus globosus* *Stereocaulon alpinum* *S. denudatum* *Thamnolia vermicularis*

(ii) LOWLANDS

Most casual visitors to Dorset, who do not penetrate inland, say that "vegetation is confined to the beaches" or, even more fatuously, that "there are hardly any plants to be seen". Nevertheless there is some element of truth in such statements, for most of the country is indeed surprisingly barren, the vegetation being properly closed only very locally in the most favourable situations. Thus Plate LXVII, looking across a broad valley, shows a "sterile" rocky foreground supporting little except crustaceous lichens. To be sure, there is "some vegetation" around the tarn in the lowland; but the low hills beyond are again almost devoid of evident vascular plants, and so are the higher ones behind, which are obscured in cloud, as they have been almost continuously during my two brief visits to this place. Plate LXVIII shows another characteristically desert, rocky and stony terrain, although here a patchy *Cassiope* heath darkens slight depressions in the low-lying, gravelly terrace in the middle distance.

It should be clear from the above that rocks and strewn boulders occupy most of the land surface around Dorset. Higher plants in these areas are largely confined to occasional individuals growing on patches of comminuted material between the rocks, as was the case on the hills (*See* above). In fact, much the same species are usually concerned. Apart from *Rhacomitrium lanuginosum*, which is almost universally plentiful, even mosses may be little in evidence. Lichens, on the other hand, are numerous and form most of the vegetation—frequently covering the rock surface with an almost continuous investment. The species are for the most part small, crustaceous, and much mixed, the following being collected on two small areas of otherwise bare rock face:

Buellia atrata
Gyrophora cylindrica and var. *delisei*
G. proboscidea
Haematomma ventosum var. *lapponicum*
Lecanora myrini
L. polytropa var. *illusoria*
Lecidea dicksonii

[1] Only the more obvious macrolichens are included, the small species of *Lecidea*, etc., being legion.

*L. flavocaerulescens**
Parmelia alpicola
P. centrifuga
P. saxatilis
Pertusaria dactylina
Polyblastia cf. *integrascens*[1]
Rhizocarpon geographicum
R. jamtlandicum
Sporastatia cinerea
Umbilicaria lyngei

Most of these species, and many others, were to be found on rock faces both on the hills and in the lowlands; indeed, the hills not being high, environmental conditions probably did not differ greatly on otherwise similar surfaces in the two instances. Many of the smaller lichens even occurred on small stones and boulders or patches of bare soil in the communities of higher plants described below, but they need not be listed again.

After rocks, the most typical and perhaps areally the most important kind of terrain around Dorset is a gravelly "barren" characterized by *Dryas integrifolia, Luzula confusa, Saxifraga oppositifolia*, and other xeromorphic plants. A typical area of such a *Dryas* barren had the following composition:

SPERMATOPHYTA	*Dryas integrifolia*	a
	Carex nardina	f
	Luzula confusa	o-f
	Epilobium latifolium	l
	Arenaria rubella	o
	Oxytropis arctobia	o
	Papaver radicatum	o
	Saxifraga oppositifolia (incl. f. *pulvinata*)	o
	S. tricuspidata	o
	Silene acaulis var. *exscapa*	o
	Festuca brachyphylla	r-o
	Astragalus alpinus	r
	Cerastium alpinum	vr
	Draba nivalis	vr
	Hierochloe alpina	vr
	Draba fladnizensis s.l.	(1)
MUSCI[2]	*Didymodon recurvirostris*	
	Polytrichum piliferum	
	Rhacomitrium lanuginosum	
LICHENES[2]	*Alectoria nigricans*	
	A. nitidula	
	A. ochroleuca	
	Cetraria nivalis	
	Cladonia uncialis	
	Cornicularia aculeata	
	C. divergens	
	Gyrophora proboscidea	
	Ochrolechia frigida	
	Sphaerophorus globosus	
	Stereocaulon denudatum	
FUNGUS	*Pyrenophora androsaces* on dead leaves of *Draba fladnizensis* s.l.	

* Report unfortunately omitted from Part II, p. 316.
[1] Cf. Part II, p. 306.
[2] Only the more important species are listed.

Although on some exposed ridges and in other unfavourable places no phanerogams were to be seen in an area of several square metres, *Dryas* more frequently covered about one-tenth of the area, the other higher plants between them accounting for another one-tenth. The *Dryas* tufts had a maximum diameter of about 50 cm., being generally much smaller, and were domed, with the centre rising to a maximum of some 8 cm. above the surrounding gravel. The cryptogams, which were chiefly lichens, were of poor growth and much mixed, only the more obvious or important of the host which were present being listed above; although including many terricolous and saxicolous species they failed to cover the surface, which accordingly remained stony and grey. This is well shown in Plate LXX, which also brings out the relative conspicuousness of

PLATE LXX

Gravelly *Dryas* "barrens" with light-coloured tufts of *Carex nardina*. The *Dryas* is in fruit; its dark patches in places show retrogression to whitish lichens. Dorset, S. Baffin, Aug. 29, 1934.

the small, light-coloured "fluffy" caespites of *Carex nardina*, and shows the dark matted tufts of the *Dryas* bearing white fruit-heads, as well as retrogressive stages of *Cetraria nivalis* (which elsewhere is unable to get a proper hold) and such light-coloured "crumbler" lichens as *Ochrolechia frigida*. In spite of the comparatively light colour of the general surface, the soil almost everywhere beneath was rather dark, suggesting that the community may be of considerable age. Especially was the soil dark and humous under the larger tufts of *Dryas;* but everywhere that the water was tested it was found to be about neutral in reaction.

Slight depressions in these barrens, where Vaccinia, *Cassiope tetragona*, and even *Empetrum* may occur, afford a better facies, which introduces the next community to be considered, viz., the mixed heath developed under more favourable conditions especially of shelter and winter snow-covering. A typical area gave the following list:

Cassiope tetragona	acod
Vaccinium uliginosum var. *alpinum*	acod
Dryas integrifolia	f-a
Vaccinium vitis-idaea var. *minor*	f-a
Carex misandra	f
Empetrum nigrum var. *hermaphroditum*	f
Salix reticulata	o-f
Equisetum variegatum	o
Luzula nivalis	o
Salix arctica	o
S. herbacea	r-o
Saxifraga oppositifolia	absent-o
Silene acaulis var. *exscapa*	absent-o
Astragalus alpinus	r
Luzula confusa	r
Oxytropis maydelliana	r
Pedicularis lanata	r
Polygonum viviparum	r
Saxifraga tricuspidata	r
Carex nardina	absent-r
Epilobium latifolium	absent-r
Lycopodium selago	absent-r
Cerastium alpinum	vr
Luzula nivalis	vr
Papaver radicatum	vr
Epilobium davuricum var. *arcticum*	(1)
Pedicularis hirsuta	(1)

Most of the above vascular plants could be found on any 1-metre quadrat, the dominance being poor and the flora correspondingly large. Indeed the whole community is far from being really luxuriant, the heaths being generally only 5 to 8 cm. high. The soil is rich, damp, and dark near the surface, but more grey, sandy, and coarse below. "Higher" vegetation covers most of the area, but is consolidated and in places interrupted by cryptogams. These are various in type and colour, and include so much *Cetraria nivalis* as to suggest that the snow-covering, if fairly good, is by no means long lasting. The chiefs of the rather few mosses are most often *Rhacomitrium lanuginosum* and *Hylocomium splendens*, and the chief lichens are various species of *Alectoria*, *Cetraria*, and *Cladonia*—also *Cornicularia divergens*, *Pertusaria coriacea*, *Sphaerophorus globosus*, *Ochrolechia frigida*, and *Thamnolia vermicularis*. An unusual number of parasitic Fungi are in evidence in such areas toward the end of August—especially *Rhytisma salicinum* on *Salix arctica*, *S. herbacea* and *S. reticulata*, *Pestalotia truncata* on (old leaves of fasciated) *Salix herbacea*, *Melampsora bigelowii* on *Salix arctica* and *S. herbacea* (which altogether seems to have rather a bad time), and *Exobasidium vaccinii* var. *myrtilli* on *Cassiope tetragona*.

What is probably the highest type of vegetation yet developed in the vicinity, in the absence of any bushy Salices or other woody plants more than a few centimetres in height, is the closed grassy sward of mixed willows, heaths, sedges, forbs, etc., developed very locally in the most favourable habitats. The situation is usually a gravelly or sandy stream-side bank or angle of a terrace,

where there is a plentiful supply of water but also good drainage and aeration, and where the local physiography is such as to ensure a goodly covering of snow in winter as well as shelter from the prevailing winds. Such areas are found fairly frequently but are almost always of small extent. A 4-metre quadrat in one example had the following phanerogamic constitution:

Salix arctica	ad
Vaccinium uliginosum var. *alpinum*	f-acod
Carex bigelowii	a
Poa arctica	a
Salix herbacea	o-a
Luzula confusa	f
Polygonum viviparum	f
Salix reticulata	f
Epilobium latifolium	l(f)
Oxyria digyna	l(f)
Dryas integrifolia	o
Luzula nivalis	o
Carex bipartita	r
Eutrema edwardsii	r
Pedicularis hirsuta	r
Pyrola grandiflora	r
Stellaria longipes	r
Campanula uniflora	vr
Cardamine bellidifolia	(1)

This may perhaps represent the preclimax, although the persistence in it of such "open soil" plants as *Dryas, Luzula confusa,* and *Epilobium latifolium* suggests that it is far from stabilized or, for that matter, homogeneously equilibrated with its allogenic environment. The soil, however, is quite dark and humous to a depth of 40 cm., although lighter coloured and almost exclusively mineral below. Mosses of various species, generally much mixed, are the chief cryptogamic "fillers", lichens being few. Rather many Fungi occur in such areas, including the following toward the end of August in 1934 or 1936:

Cintractia caricis on *Carex bipartita*
Exobasidium vaccinii-uliginosi on *Vaccinium uliginosum* var. *alpinum*
Pseudopeziza drabae on *Draba fladnizensis* s.l.
Puccinia eutremae on *Eutrema edwardsii*
Rhytisma salicinum on *Salix arctica* and *S. herbacea*
Russula fragiles
Sphaerospora trechispora
Ustilago inflorescentiae on *Polygonum viviparum*
U. vinosa on *Oxyria digyna*

(iii) MARSHES

Although in the lowlands around Dorset there are many irregular, muddy or marshy areas of the type described under (vi) below, and well figured by Soper (1928, photo B on p. 133), I have seen few fully closed marshes of any real extent. One is seen forming a fairly broad zone around a tarn in Plate LXXI, which, however, shows relatively barren, stony mud still persisting in places. A small area toward the periphery of this marsh, where it was properly established and consolidated by numerous mosses, had the following composition as regards vascular plants:[1]

Carex aquatilis var. *stans*	a-vad
Eriophorum angustifolium	a-cod
Arctagrostis latifolia	o-ld
Carex membranacea	f-a
C. atrofusca	f

[1] There was no peat accumulation, the thin but dark, wet, humous soil being where tested exactly neutral in reaction

Dupontia fisheri	f
Carex rariflora	l
Saxifraga aizoides	l
Equisetum variegatum	o
Hierochloe pauciflora	o
Juncus biglumis	o
J. albescens	o
Salix arctophila	o
Carex saxatilis var. *miliaris*	r-o
C. bipartita[1]	r
Juncus castaneus	r
Poa arctica	r
Polygonum viviparum	r
Saxifraga hirculus var. *propinqua*	r
S. stellaris var. *comosa*	r
Cardamine pratensis var. *angustifolia*	vr
Salix arctica	vr
Epilobium davuricum var. *arcticum*	(1 colony)
Tofieldia pusilla (T. borealis)	(1)

Unlike the situation with most other habitats, this list is very closely comparable with ones made on similar areas at Lake Harbour. The consolidation is, however, less complete at Dorset, there being left here quite frequent

PLATE LXXI

Lakeside marsh dominated by ***Eriophorum angustifolium, Arctagrostis latifolia,*** and Carices. In the foreground are seen open mud and shallow water, both being colonized by ***Eriophorum scheuchzeri.*** Dorset, S. Baffin, Aug. 25, 1936.

muddy depressions that allow ecesis of plants unable to withstand the competition of the otherwise strong dominants. Good examples of these weaklings are *Juncus biglumis* and *Epilobium davuricum* var. *arcticum.* This chief difference is in full conformity with the general situation, viz., that the vegetation is poorer at Dorset than at Lake Harbour.

[1]Generally infected with *Cintractia caricis.*

(iv) SNOW EFFECT

With the appreciably cooler and later summer (and perhaps greater precipitation?), late-snow patches at Dorset cover much more extensive areas than at Lake Harbour. Also, the zones tend to be more numerous, although frequently they are rather poorly delimited. Much the same sequence and even species being concerned as at Clyde, already described fully above, and Lake Harbour, whence the two most characteristic zones were listed (*See* pp. 147 *et seq.*), it will suffice here to give an outline of the subclimax zones typically encountered in rockbound lowland terrain where the snow drifts deeply in winter and, in the centre of such areas, melts only toward the end of summer or in some years not at all.

Zone I. This is developed where snow lies deeply but melts relatively early—as in many places in the lowlands in slight depressions that may lack later-melting, inner zones. It is characterized and usually dominated by *Cassiope tetragona*,[1] often with *Empetrum* and other "heaths" of good growth, and almost always with associated herbs such as *Hierochloe alpina, Luzula confusa, Carex bigelowii, C. misandra, Lycopodium selago,* etc., etc. The area appears dark from a distance, due principally to the *Cassiope*—cf. Plate LXVIII—in spite of the presence of light-coloured lichens such as *Stereocaulon alpinum* and *Ochrolechia frigida* between the rather irregular patches of the dominant. The soil is often dark and humous and decidedly acid in reaction, pH 5·2 and 5·4 being measured in two instances, whereas nothing so low was found in the inner zones.

Zone II. This, where the snow is definitely "late" in melting, is characterized and most frequently dominated by *Salix herbacea,* as elsewhere in the central and southern parts of the Canadian Eastern Arctic. Luzulae are the most constant associates, or, toward the outside, where they sometimes form a narrow zone of their own, *Salix arctica* and *S. reticulata. Cassiope hypnoides* is frequently to be found here, but the dominance of the microshrubs is such that herbs are often very few. Among cryptogams, *Ochrolechia frigida* may still be plentiful.

Zone III. Here the growing-season is too short for most woody plants and an herbaceous "half-barren" is usually found. The species are very variable, the most constant and characteristic being *Arenaria sajanensis, Carex bipartita, Luzula confusa, Oxyria digyna, Poa arctica, Sagina intermedia, Silene acaulis* var. *exscapa, Trisetum spicatum* var. *maidenii,* and various Saxifragae. The cryptogams are for the most part characteristic snow-patch species such as *Gymnomitrium corallioides, Solorina crocea,* and numerous squamules of *Ochrolechia* and *Stereocaulon.*

Zone IV. A herb "barren" of, most characteristically, *Phippsia (Catabrosa) algida, Cerastium alpinum, Draba fladnizensis, Luzula confusa, Potentilla hyparctica* f. *tardinix (P. emarginata* f. *tardinix), Saxifraga caespitosa* subsp. *eucaespitosa* f. *uniflora, S. cernua, S. nivalis,* and *S. rivularis.* In this zone many of the above and often some other species are to be found still in flower at the end of August in an average year. Lichens are here few and usually of poor growth.

Zone V. In the latest snow-patches a still more barren zone, in which the stones are largely devoid even of crustaceous lichens, is developed where the snow lies longest of all. *Phippsia (Catabrosa) algida* is often the only phanerogam to attain more than the seedling stage, Bryophyta comprising most of the virtually

[1] Frequently parasitized by *Exobasidium vaccinii* var. *myrtilli.*

negligible flora. In the most lastingly damp run-off areas, mosses may form a thin mat very locally, but are rarely of any real importance or extent. Indeed I now fear that my earlier field experiences in Lapland and on Akpatok Island, and especially in the higher Alps and Rocky Mountains, where thicker "moss-mats of late-melting snow" are highly characteristic, may have led me to expect similar communities all over the Eastern Arctic, and to exaggerate the importance of such small mats as do occur.

(V) SPECIAL LOCALIZED AREAS

The chief communities of raised beaches and gravelly terraces, which are so plentiful around Dorset as scarcely to rate as "special", have already been considered above, for it is usually such areas that support the more luxuriant dry-land vegetation to be seen in the lowlands (cf. p. 165 *et seq.*).

The only further outstanding type that is not covered by some other heading, at least in a general way, is the Eskimo settlement. This, though comparatively large,[1] is areally quite insignificant, but the communities are so interesting that a few notes are indicated. The terrain is, of course, disturbed and liable to almost constant manuring. The most notable characteristic is its luxuriant grassiness—due chiefly to *Poa glauca*, whose dense caespites are usually separate but sport innumerable long culms that arch to cover most of the intervening area. Associated plants are many and various, especially around pools, which may support a dense algal scum and many large aquatic Invertebrata *(Branchinecta, Lepidurus,* etc.) as well as marginal communities of extreme luxuriance. Just here *Alopecurus alpinus* is plentiful and *Cardamine pratensis* var. *angustifolia* attains a foot in height and blossoms abundantly in late August, although in the surrounding areas I have only seen it in the vegetative condition and very dwarfed. Plants regularly associated with the settlement but not seen in the surrounding areas even where local physiographic conditions appeared identical, and hence supposedly owing their presence *just here* to mankind, are as follows:

SPERMATOPHYTA	*Arabis arenicola*
	Chrysosplenium alternifolium var. *tetrandrum*
	Draba alpina var. *inflatisiliqua*
	D. cinerea
	Lychnis furcata
	Poa pratensis s.l.
	Ranunculus trichophyllus var. *eradicatus*
	Saxifraga hirculus (typical form)
	Stellaria crassifolia
	Taraxacum ceratophorum?
	T. lacerum
BRYOPHYTA	*Aulacomnium palustre*
	Bryum sp. (sterile)
	Marchantia polymorpha
	Mnium affine
FUNGI	several Agarics
	Stigmatea ranunculi on *Ranunculus nivalis*
ALGA	*Prasiola crispa*[2]

It would be interesting to know how many of these are of frequent occurrence in this general region (as opposed to the few immediately surrounding areas that I have had an opportunity of exploring); also, whether any have been transported from afar. According to Lord Tweedsmuir (*in litt.*, 1939) the majority

[1] Eskimo populations in Canada are still almost always seasonally "shifting" ones, that of Dorset comprising some four hundred people.

[2] Cf. footnote (1) on page 29.

of the flowering plants, at all events, are to be seen here and there elsewhere in the district, and I consider it probable that, with the possible exception of the almost cosmopolitan lower cryptogams, they are all true natives.

(vi) FRESHWATER

The only observations that I have made on freshwater streams in the district are that they are generally ephemeral and, consequently, largely barren (except for occasional richness in microscopic forms), although in one instance numerous very hard and dense, dark brown colonies of *Rivularia dura* were noted. However, bodies of more or less permanent standing water may support fairly numerous Algae, besides aquatic mosses and a few phanerogams.[1] Thus, on one tarn there were floating masses composed of such species as *Aphanocapsa grevillea, Nostoc pruniforme,* and *Rhizoclonium hieroglyphicum* var. *horsfordii.* Among these, or on nearby rotting leaves of *Carex aquatilis,* were to be found in late August, 1936, the following species and intraspecific entities belonging to various algal groups (the diatoms were identified in a sample taken from an inflowing streamlet):

Achnanthes flexella
A. minutissima var. *cryptocephala*
Aphanothece clathrata
Caloneis silicula var. *alpina*
Calothrix braunii
Ceratoneis arcus
Chroococcus turgidus
Coleochaete scutata
Cosmarium botrytis
C. cucurbita[2]
C. granatum
C. quadratum
Cymbella angustata var. *hybrida* and var. *linearis*
C. scotica var. *incerta*
C. stauroneiformis
C. subaequalis var. *oblonga*
C. turgida
C. ventricosa var. *genuina*
Denticula tenuis var. *intermedia*
Diatomella balfouriana
Eunotia arcus
E. bigibba var. *pumila*
E. fallax var. *gracillima* and var. *typica*
E. praerupta var. *genuina*
E. valida
Gomphonema micropus
G. mustela
Meridion circulare
Merismopedia minima
Navicula brachysira
N. styriaca
N. vulpina
N. zellensis var. *linearis* and var. *typica*
Nitzschia amphibia
N. angustata
N. frustulum
Nostoc commune
N. sphaericum
Oscillatoria tenuis
Pinnularia hudsonensis
P. spitsbergensis

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[1] Including in one instance just behind the Hudson's Bay Company's post, abundant *Ranunculus trichophyllus* var. *eradicatus.*

[2] The record of this species from Dorset was inadvertently omitted from Part II, p. 77.

P. viridis var. *commutata* and var. *intermedia*
Rivularia biasolettiana
Sphaerozosma granulatum
Staurastrum clepsydra var. *sibiricum*
Stauroneis anceps var. *amphicephala*
S. perpusilla var. *obtusiuscula*
Synedra acus var. *mesoleia*
S. amphicephala
S. ulna var. *genuina*
Tabellaria fenestrata
T. flocculosa
Tolypothrix tenuis

The marginal communities of lakes and tarns are drastically and obviously variable from spot to spot, as is well seen in Plate LXXI, where luxuriant beds of *Carex aquatilis* (often the tall, typical form and up to 50 cm. high, which was not exceeded by any other plant seen in the district) and *Eriophorum angustifolium* extend from the closed marginal marshes far out into the water in some places, whereas in others, where the water is similarly shallow and the bed appears just as favourable for colonization, semi-barrenness still prevails. Thus the area of mud and stones in the foreground is colonized by little except *Eriophorum scheuchzeri* in sparsely open formation. Elsewhere the hygrophytic denizens of open and periodically inundated mud are likely to be more numerous, including the majority of the marsh species listed on pages 169-70. The most typical plants on the open silty areas between the patches of higher vegetation on such terrain as the "Marshy resort for the early shore birds" so well figured by Soper (1928, photo B on p. 133), are as follows:

VASCULARES	*Alopecurus alpinus* *Arctagrostis latifolia* *Cardamine pratensis* var. *angustifolia* (vegetative only, cf. p. 172) *Carex aquatilis* var. *stans* *C. atrofusca* *C. bicolor* *C. membranacea* *Deschampsia pumila* *Dupontia fisheri* *Epilobium davuricum* var. *arcticum* *Equisetum variegatum* *Eriophorum angustifolium* *E. scheuchzeri* *Juncus albescens* *J. biglumis* *J. castaneus* *Lychnis apetala* *Phippsia (Catabrosa) algida* *Pleuropogon sabinii* *Ranunculus hyperboreus* *Saxifraga nivalis* *S. rivularis* *S. stellaris* var. *comosa*
MUSCI	*Calliergon sarmentosum* *C. trifarium* *Scorpidium scorpioides* *Sphagnum fuscum*
ALGAE	Various colonial, etc., Cyanophyceae (especially gelatinous *Nostoc* spp.) *Sphaerella nivalis* ?[1]

[1]Specimen unfortunately lost. "Red snow" was seen on old drifts in the neighbourhood. *See* also p. 130.

(vii) SEASHORE

The between tide foreshores visited at Dorset, where the maximum rise and fall is about 25 feet (7·7 m.), were either of smoothed rock or else clayey mud strewn with boulders of irregular shape and size in the manner shown in Plate LXXII. Here, except for much *Fucus vesiculosus* clothing the larger boulders,

PLATE LXXII

Foreshore from just above high tide-mark. In the foreground are irregular mats of *Puccinellia phryganodes* that higher up become more or less continuous. Above the dark drift-line, at the level of the Eskimo child's head, are beds of *Elymus arenarius* var. *villosissimus*. Dorset, S. Baffin, Aug. 29, 1934.

macroscopic Algae were few, although the little *Asperococcus echinatus* was to be found in abundance in some pools. However, even far below high tide-mark (e.g., in the foreground of Plate LXXII, which was taken from only just above half tide-mark) there are to be found luxuriant mats of *Puccinellia phryganodes*. These generally increase in size and redness and the tendency to flower (although probably no fruit is ripened) as high tide-mark is approached and ultimately exceeded (cf. M. P. Porsild 1920, p. 43). Higher up, on the dry surfaced, gravelly or shingly strand, occur the usual colonists of such areas, viz., *Elymus arenarius* var. *villosissimus*, *Mertensia maritima* var. *tenella*, and *Arenaria peploides* var. *diffusa*—the first named, especially, binding the surface and forming the close beds seen in Plate LXXII a little above the dark drift-line (just on the level of the Eskimo child's head as viewed from the camera).

Farther back, the community in most places passes more or less quickly and directly to *Dryas* barrens or some other typical lowland formation, but in sheltered muddy situations a miniature "saltmarsh" is apt to develop. As elsewhere, this is typically dominated by close, matted *Puccinellia phryganodes*,

although higher up this latter becomes less and less overwhelmingly dominant and other plants enter the sward. A 4-metre quadrat, about halfway up to the ongoing slope of typical land vegetation, had the following composition:

SPERMATOPHYTA	*Puccinellia phryganodes*	vad
	Carex ursina	lvad
	C. salina apprg. var. *subspathacea*	a
	Stellaria humifusa	f
	Puccinellia paupercula	f
	Cochlearia officinalis var. (seedlings)	r
MUSCUS	*Calliergon sarmentosum*	r
ALGAE	*Enteromorpha ramulosa*	
	Ulothrix flacca	

Slightly higher up, where only the highest tides reached them, were plentiful examples of the following more or less typical (some of them exclusively) shore plants:

Carex bipartita var. *amphigena*
C. maritima
C. salina (phases apprg. *C. aquatilis* var. *stans*)
Koenigia islandica
Matricaria inodora var. *nana*
Montia lamprosperma
Phippsia (Catabrosa) algida
Poa glauca
Saxifraga rivularis
Stellaria longipes f. *humilis*

6. MELVILLE PENINSULA

This, with the various accompanying islands, has an area of approximately 25,000 square miles, and extends from about latitude 69° 50′ N. southwards to latitude 65° 35′ N., and from longitude 81° W. to longitude 87° 20′ W. In the absence of any precise modern data on the local vegetation and ecology, we shall have to deal with this region rather briefly. The outline of the land, which in the broadest sense is compact and oval, is rendered irregular by numerous bays and occasional deeper indentations. Good, first-hand accounts, often with illustrations, of the topography and local physiography of different parts have been given by Parry (cf. 1824), Rae (cf. 1850), Mathiassen (1933, especially pp. 69-85), and some others. From these it is clear that the land is for the most part rather low, remaining less than 300 feet (91 m.) in altitude over considerable areas, and rarely exceeding 1,000 feet. Much of the interior is of plateau land some 800 feet high (Bethune 1937, p. 30), and elevations up to 1,300 feet have been noted in the north near Fury and Hecla Strait, but there are no peaked mountain ranges, even if some of the uplands appear rugged and mountainous to observers from near the shore where the country is low, or from the air as we saw in August, 1946. There are several rivers of considerable size, and many lakes near the coast; inland the country is almost entirely unknown.

There is no great ice-cap, and no ice-fields of major extent persist, although the country almost everywhere shows signs of intense glaciation. Glacial striæ have been seen in a number of places, usually running to the southeast. Most of the lowland area is occupied not by bedrock or loose weathered material but by glacial deposits that have been rewashed by marine agency;

these deposits with their included "subfossil" shells, as well as various other features, indicate that the lowlands have risen out of the sea only in comparatively recent times. Again, other great areas of the lowland, especially in limestone districts, are occupied by series of long and low "beach ridges", which rise in monotonous succession and may still remain virtually unvegetated even when situated quite a long way inland.

GEOLOGY[1]

Most of the land near the sea and for at least some distance inland, including almost the whole of the north, west, and south coasts, as well as the southern half of the east coast, is of Archæan rock, chiefly dark grey or reddish gneiss. This in most places extends for some distance inland, but whether it also occupies the central regions has not been determined, although this seems highly probable.[2] Associated with the usually predominant gneisses are, frequently, dykes of quartz or pegmatite, and, in various places, feldspar, quartzite, soapstone, graphite, etc. The lowlands are frequently occupied by rewashed marine deposits, which in places persist to considerable altitudes.

In contrast with the typically dark and hilly terrain composing most of Melville Peninsula, the northern half of the east coast and the accompanying hinterland and islands are of light-coloured and almost flat limestone material, apparently of Ordovician age (cf. Teichert 1937). The bedrock is rather rarely exposed, the surface consisting generally of loose *fjellmark* or other material. This often forms a monotonous series of beach ridges that rise, one behind another "quite regularly" and very gradually, in toward the interior.

CLIMATE

As its geographical position and general similarity would lead one to expect, Melville Peninsula belongs to the same temperature regime as most of northern Baffin. It probably has a similar precipitation as well. The following table gives the more important temperature data collected on board H.M.S. *Fury,* one of Parry's ships during his 'second' expedition, throughout the 23 months spent in the vicinity of Melville Peninsula. This was in 1821-3, and I have extracted the information from Parry's own account (1824, pp. 131 *et seq.*); during this time the meteorological station thus constituted was at Winter Island (latitude c. 66° 15′ N., longitude 83° 5′ W.) from the second to the ninth months, both inclusive, then for some 3 months at sea off the east coast of Melville Peninsula, and thereafter at Igloolik for 10 months. During the final month they were sailing southwards down the east coast, off which they had spent also part of the first month.

Except that they show less extreme fluctuations, possibly due to the maritime situation, these figures are rather closely comparable with the ones given on page 62 for Pond Inlet in northern Baffin.

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[1]Gleaned from various sources, including the works of Parry, Rae, and Mathiassen cited above.

[2] This indeed appeared to me from the air to be the case over at least the southern two-thirds of the long axis of the peninsula over which we flew in 1946.

Melville Peninsula, 1821-3. Temperatures in °F.

Year	Month	Maximum	Minimum	Monthly mean
1821	October	32*	−13	12·51
	November	28	−20	7·75
	December	2	−21	−12·94
1822	January	− 6	−37·5	−22·96
	February	− 4	−37	−24·97
	March	13	−35	−11·64
	April	29	−12	5·51
	May	46	− 5	23·09
	June	50	20	33·97
	July	54	30	36·34
	August	50	27	33·68
	September	37	11	24·45
	October	29	− 9	12·8
	November	8	−32	−19·4
	December	−10	−43	−27·8
1823	January	22	−45	−17·07
	February	21	−43	−20·41
	March	4	−41	−19·75
	April	32	−25	− 1·68
	May	49·5	− 8	24·85
	June	52	8	32·16
	July	59	30	40·04
	August	55	24	37·77

* Evidently not, as stated by Parry, 32½. This maximum at the critical point was recorded in the entrance of Lyon Inlet, where the *Fury* lay for the first 6 days of the month.

VEGETATION

As has already been stated, I have been unable to gather any recent and reliable information on the vegetation of Melville Peninsula, except of the most general nature, and am forced for this brief account to fall back on observations made in most cases more than, and in few cases much less than, a century ago.

That the vegetation is everywhere of the rather dwarfed arctic type it seems quite safe to conclude, both from the observations of recent visitors and from the published reports of the earlier explorers. In the latter category the chief, as well as the earliest, were Parry and his officers (including Captain Lyon), who spent most of the time from October 1821 to August 1823 in the south, east, and north of this region,[1] and Dr. John Rae, whose explorations in the south and southwestern parts up to three decades later aroused much interest as a result of his chancing upon relics of the missing Franklin expedition. That a useful covering of vegetation is to be found in many places is evident from the reports of Lyon (cf. 1824), Parry (cf. 1824), and Rae (cf. 1850); in fact, it is chiefly the visitors whose previous experience had been confined to southern climes, or others who have not set foot on the land at all, who have spoken so derogatorily of, for example, "the desolate shores of Melville Peninsula" (Richardson 1825, p. 321). Sir John Richardson was, however, an experienced scientist as well as a medical man, and we can rely on the other, more definite statements that he makes in the appendix to Parry's journal (cf. 1825), even if those regarding

[1] Parry and his officers during their 'second' expedition collected plants actively and intelligently on Melville Peninsula and its adjacent islands, considerable numbers of their specimens being well preserved to this day (cf. Polunin MS.a, MS.e, MS.i, MS.k, MS.l). The good work was energetically continued in nearby parts of northern Baffin and Somerset Island during Parry's 'third' expedition (cf. Polunin MS.b, MS.i, MS.j), though unfortunately no studies appear to have been made of the plant populations or resultant vegetation on any of these trips: the world had to wait another century for that kind of thing.

the food, etc., of the animals to be found in these regions are concerned chiefly with the "barren grounds" to the southwest—cf. his references to *Betula glandulosa* (*l.c.* pp. 312 and 321), which is not yet definitely known to occur on Melville Peninsula,[1] even if the implications are that it may do so (cf. Parry 1824, p. 501).

With regard to the general features, Freuchen and Mathiassen (1925, p. 555), after much first-hand experience of the country, write as follows: "For the most part the peninsula offers a landscape of monotonous plains of recent unconsolidated material from which project low granite knolls of a rather rugged gneissic topography. As a rule the plains are occupied by shallow lakes or marshes, often overgrown with rushes (*Carex*), willows, saxifrage, cassiope, dryas, and various kinds of grasses". Later on (p. 558), the same authors report that "Driftwood was never seen along the coast, and the plant life is of little direct use for the Eskimos. Some cassiope and willows that attain a height of about half a metre in sheltered places in the extreme south of the peninsula are used for firewood, and the branches are braided into mats to be used underneath the skins in the snow huts. A few berries ripen during the summer but are not always gathered". With regard to these relatively large willows, which are scarcely even approached in height by the largest specimens of forbs that I have examined from the district, it seems unlikely that they are ever of more than low-bush form, or on the other hand that they are much exceeded in height by any other plants on the peninsula. Even though it is reported of Hall (1879, p. 357) that after long travels in the region he found in one place in Hoppner Inlet "an abundant growth of wood in a cluster of undergrowth showing some creeping trees which spread themselves out", and that one of these (presumably the biggest) was "11 feet in length and 2 inches in diameter at the base", it appears from the ensuing narrative that these "trees" are mere creepers or prostrate espaliers.

Parry's notes on the use of plants by the local Eskimos may with advantage be quoted here. He writes (1824, p. 501) particularly of the employment of twigs of birch (presumably *Betula glandulosa*, which they import from the south—*See* above) and of *Cassiope tetragona* (sub nom. *Andromeda tetragona*) for beds, and adds (p. 505) that "they sometimes eat the leaves of sorrel, (*kōngŏlek,*) and those of the ground willow; as also the red berries, (*paōōnarootik,*) of the *vaccinum uliginosum* (sic), and the root of the *potentilla pulchella;* but these cannot be said to form a part of their regular diet; scurvy grass they never eat."

Regarding the surface features Jameson writes (1826, p. 134) that "Captain Parry . . . informs me, that 'loose mineral matter of any kind seldom exceeds a foot in thickness; and beneath this the ground is literally frozen as hard as a rock, a pick-axe only bringing off dust and mere fragments, as from a mass of granite.' Over this *sub-soil* lies a layer, more or less thick, of vegetable soil. The depth of the vegetable soil, Captain Parry informs me, 'seldom exceeds a very few, perhaps from four to five, inches, and that only in a few insulated spots, sheltered and otherwise favourable for vegetation'. More frequently, however, the bare surfaces of the strata are exposed to the weather, and on these, and in the chinks of the rocks, a few plants, frequently cryptogamous, are seen struggling for existence".

[1] In like manner is Richardson's report (1825, p. 291) of *Hedysarum* concerned only with the mainland regions to the south and west.

Of the islands in or near Fury and Hecla Strait, which separates the north coast of Melville Peninsula from the adjacent coast of northwest Baffin, the geological formation is variable. Thus Liddon Island, which consists of "brown sandstones containing lumps of quartz", is said to be "almost entirely barren of the productions of the animal and the vegetable kingdoms. Of the former we saw only a single herd of deer, and the little vegetation which might have afforded them subsistence, was now permanently covered with a coating of snow . . ." (already on August 31, 1822—*See* Parry 1824, pp. 324-5). Amherst Island, to the west[1], is composed of various sediments, the northern half, which is of hard and resonant limestone, being according to Lyon (1824, p. 270) "entirely void of vegetation", whereas the southern part, which is covered with blackish schist, supports "in the valleys or swampy places, a very scanty covering of moss and shrivelled grass; on this we saw eight deer feeding" (Lyon *l.c.*).

The island of Igloolik (or Iglulik, "the place of igloos", latitude 69° 22′N., longitude 81° 43′ W.), seat of the chief Eskimo settlement in these regions, is of yellow or grey limestone[2] and mostly very low, the surface consisting almost entirely of "raised beaches of loose stones, rising one behind the other quite regularly and very slowly in towards the interior. These raised beaches are always bare, but the hollows between them are full of snow in winter, in summer partly full of swampy ground and small lakes, and to some extent covered with vegetation" (Mathiassen 1933, p. 71). Somewhat at variance with this report is the (rather fanciful ?) contention of Lyon (1824, pp. 446-7) about Igloolik that, with the exception of one part, which reaches an altitude of 174 feet (53 m.), "the whole island may be considered as one immense swamp, full of lakes, and covered with stunted herbage. A few ridges of gravel occur occasionally". Lyon also notes (1824, pp. 406-7) that as early as May, "Walking on shore on the 9th, I found a great number of caterpillars crawling about on the snow, and on such small spots of land as lay bare. Amongst the few little tufts of herbage which were exposed, I picked about a dozen buds of the following plants: *Cerastium alpinum, Arenaria rubella, Saxifraga oppositifolia, Andromeda tetragona,* and *Salix herbacea*".

Of one place on Igloolik, Parry wrote (1824, p. 280) that "We found here a very abundant vegetation, which is much favoured by the numerous streamlets and ponds, as well as by the manure afforded by the permanent residence of the Esquimaux near this spot. In some places were many hundred yards of square space covered with moss of a beautiful soft velvet-like appearance, and of a bright green colour such as I never saw before; and perhaps indeed moss cannot well be more luxuriant".

Finally it may be mentioned concerning Igloolik that Hooker (1825, p. 428) reports *Sphaerella nivalis* (sub nom. *Palmella nivalis*) from this place ". . . . On snow; and also attached to stones and covering mosses with a thin gelatinous crust". Hooker goes on to describe a tract of this "red snow" 8 miles (13 km.) long, but his report that the Alga occurred "frequently to a depth through the snow of ten or twelve feet" must not merely "excite our astonishment" but be due to some drifting or other phenomenon.

The closely adjacent island of Neerlo Nakto (or Nerdlernartoq, latitude 69° 30′ N., longitude 82° W.) is said by Parry (1824, p. 304) to consist of similar terrain. On the other hand, the mainland of the northernmost part of

[1] Contrast the map of Mathiassen (1933, at back), which gives the impression that this westernmost unit of the local archipelago is named Liddon Island.

[2] Of Ordovician age, according to Teichert (1937, cf. map at end), and not, as previously supposed, Silurian.

the peninsula, lying to the west along the south shore of Fury and Hecla Strait, is mostly of granite and gneiss (Mathiassen 1933, pp. 69-70) and would seem to be in places fairly well vegetated, although Cape North East (latitude 69° 40′ N., longitude 82° 30′ W.) is, according to Parry (1824, p. 312), "inconceivably barren and desolate, with scarcely a tuft of moss or grass". The land "abreast the west end of Amherst Island" and westwards is less rugged than to the east, the hills "having at their foot a sloping plain covered with fine pasturage, extending in one place four or five miles towards the sea" (Parry 1824, p. 339). Other excursions in these regions, chiefly made while Parry's expedition had its headquarters at Igloolik, revealed such features as the first flowering of *Saxifraga oppositifolia* in mid-June near where "At the foot of the mountains the plains are well furnished with grass" (Lyon 1824, p. 430), although the seasons may be very late (*ibid.*, pp. 267-8).

In the region of Richards Bay, Parry mentions (1824, p. 333) "some pleasant valleys covered with grass and other vegetation, and the resort of numerous reindeer", and also a low tableland "covered with abundant vegetation, as well as intersected by numerous ponds of water". Here they were directed to their tent at dusk "by a cheerful blazing fire" of *Cassiope tetragona.* A little to the southwest of here, around Quilliam Creek, Lyon reported that toward the end of June in 1823 "the grasses and mosses were shooting luxuriantly, and promised abundant provision to the vast quantities of deer which we continually saw" (Parry 1824, p. 448, and cf. p. 441).

For a long distance to the south, indeed until the last quarter of the way to Barrow River (latitude 67° 14′ N., longitude 81° 22′ W.), the east coast and immediate hinterland is of relatively flat and poorly vegetated limestone, with monotonous series of raised beaches near the sea, the whole looking like the terrain at Igloolik (*See* above). However, through this southern quarter and almost everywhere to the south of Barrow River, the east coast is of Archæan rocks, on which the vegetation is in general more considerable. Thus, according to Mathiassen (1933, p. 76), and he rarely mentions vegetation phenomena, Daugaard Jensen River has its lower course "through a low, grassy plain", and Jameson reports (1826, p. 134) of Barrow River that "Its banks are frequently steep and lofty, in some places being nearly 200 feet high, and ornamented by a vegetation unusually luxuriant for so severe a climate" (cf. also Parry 1824, p. 265). Lyon rather fancifully reports (1824, p. 223) that farther inland "Rocks of gneiss and granite sometimes hemmed the stream, but more generally its shores were gently sloping from the plains, which abounded in flowery vegetation; it was impossible to look on this first interesting country we had seen, without fancying that the air was scented. . . ."

In another landing place on the east coast, as late as July 10, "The valleys were swampy, and in one of them, there was a lake of about two miles in length, where moss and rank grass were abundant; but the only two plants we saw in flower were the blue saxifrage and a few yellow poppies. Sorrel was found, but of so diminutive a size as merely to suffice to show itself amongst short moss. The whole scene was desolate in the extreme" (Lyon 1824, p. 220). Parry also reports (1824, p. 261) of this eastern coast that "There was no absolute want of vegetation, many considerable patches occurring entirely covered with moss, grass, and other plants; but the whole of these were in a remarkably backward state, the *saxifraga oppositifolia* being, I believe, the only one as yet in flower.

The *andromeda tetragona*[1] was here very abundant, and numerous tufts of sorrel were just putting forth their first red leaves. A number of rein-deer were seen, but they proved too wild for us, and birds were unusually scarce".

Farther south, opposite Winter Island, the vegetation appears to be rather poor, to judge from reports of springtime explorations by Lyon (1824, p. 198) and Parry (1824, p. 232), and certainly on Winter Island itself (about 66° 15′ N. and 83° W.) the summer is apt to be very late in commencing (cf. Parry 1824, pp. 235-6 and 241, also Lyon 1824, p. 211). Both these authors remark on the singularity of the finding of the first flower, *Saxifraga oppositifolia*, on June 9 on Winter Island in 1822, i.e., one day later than it had appeared in 1820 on Melville Island, although this is some 9 degrees of latitude farther north (Parry 1824, p. 240, and Lyon 1824, p. 205). Although summer, as opposed to the springtime awakening period, may not come to the general vegetation until the very end of June (cf. Parry 1824, p. 245), there appears still to be time for fairly good growth. Thus Parry's expedition made a "vegetable garden" in 1822 (cf. Parry 1824, pp. 211 *et seq.*), from which they obtained (though apparently under glass) "some radishes, onions, and mustard and cress . . . . The onions had a very pungent smell and taste, and the whole were in that healthy state which, however dwarfish their growth, would have rendered them very acceptable if more abundant".

In and around Lyon Inlet, to the west of Winter Island, the gneissic and granitic hills are irregular in outline and apparently barren on their tops (Lyon 1824, p. 100) "except in the valleys and smaller hollows, where the vegetation, as well as moisture, was abundant" (cf. Lyon 1824, p. 71, and Parry 1824, p. 89). There is a strong suggestion that *Betula glandulosa* var. *sibirica* (or just possibly *B. nana*—*See* Part I, p. 174) may occur in this region (cf. Lyon 1824, p. 71), although so far as I am aware none has yet been seen growing there (*See* above). Around Hoppner Inlet, a northern branch from Lyon Inlet, the vegetation would seem to be relatively luxuriant. Thus Parry writes (1824, pp. 83-4) that it "was abundant, consisting chiefly of short thick grass, moss, the *andromeda tetragona*[1] and *ledum palustre*,[2] a sweet smelling plant which here grew very luxuriantly. Much of the ground was wet and swampy, small lakes occurring in almost every hollow, and numerous streams of water running from the hills". It was also hereabouts that Hall (1879, p. 357) found the unusually large willows mentioned on page 179.

A little farther west again, on the south coast near Georgina Island, the vegetation is again "tolerably luxuriant" (Parry 1824, p. 107), the valleys being "fertile in grasses and moss" (Lyon 1824, p. 67). Hereabouts "there was no want of feeding for" deer and hares, and "The ground-willow was very plentiful, and so dry at this season that we easily procured enough for keeping up a good fire all day" (Parry 1824, p. 107). Elsewhere on the Frozen Strait coast "On the banks of the lakes the vegetation was quite luxuriant, giving them when viewed from an eminence and assisted by bright sunshine a cheerful and picturesque appearance" (Parry 1824, p. 69). 'Red snow' has been found in this region (cf. Parry 1824, p. 65).

Around Repulse Bay the land is nowhere very high, and on the north coast, with which alone we are here concerned, it is said not to exceed 700 feet (213 m.). The predominant rock is gneiss, and it forms "an endless series of rounded ridges

[1]*Cassiope tetragona.* (N.P.)

[2]Doubtless the usual American var. *decumbens.* (N.P.)

with a sloping north side and a scarp on the south side" (Mathiassen 1933, p. 84). According to Parry (1824, p. 52) "There was here no want of vegetation, which indeed was in many parts extremely luxuriant"—although this may, one is prone to think, have been merely in contrast with Melville Island (where Parry had spent 1819-20) and the poor limestone, etc., of York Bay, Southampton Island, whence his current expedition had recently come. Thus the implications of Rae (1850, p. 91) and Rasmussen (1931, p. 8) are that the vegetation is rather poor, at least around the head of Repulse Bay, where Burwash (1931, p. 48) speaks of the hills as being bold and rugged, even if "between . . . . lie grassy valleys".

Inland, to the northwest, in Rae Isthmus, the vegetation would seem to be much better developed. Thus, in the region of North Pole Lake, "enclosed by hills of a hundred to a hundred and fifty metres' height", Rasmussen reports (1931, p. 8) "We came out on to wide plains with smooth slopes, where grass and dwarf willow emerged through the snow. . .", whereas around Muddy Lake (latitude 67° 4′ N.) "The shores. . . .being covered with a rich pasturage and a great variety of flowers, afforded a pleasing contrast to the country we had hitherto travelled through" (Rae 1850, p. 48). Rae also found "some very fine heather" (presumably *Cassiope tetragona*) for fuel at Christie Lake (*l.c.*, p. 164), and near the Committee Bay coast Burwash (1931, pp. 46-8) speaks of crossing "a wide grassy flat", and then of climbing "steeply several hundred feet to a grassy plateau which was dotted with ponds and small lakes."

The west coast of Melville Peninsula is little known, having been, so far as I am aware, visited at all extensively by only one white party. This was the outfit of Rae, who gives the impression that the vegetation is very scanty in most places. Thus he reports (*l.c.*, p. 50) that Point Hargrave, latitude 67° 15′ N., "is formed of granite and gneiss, and has a very rugged appearance, there being neither moss nor grass to soften their asperities". Again, concerning Cape Simpson (c. latitude 68° 5′ N., longitude 85° 45′ W.), Rae notes (1850, p. 141) that "The shores were very barren, there being little or no vegetation to be seen, except small patches in the crevices of the rocks". Nevertheless, it is evident that a fair degree of vegetative development, probably of the usual kinds, takes place in sheltered situations. Thus along the borders of a creek in Fraser Bay, north of Selkirk Bay, Rae speaks (1850, p. 149) of the existence of great quantities of growing fuel (probably *Cassiope tetragona*).

This entirely preliminary account of the terrain and vegetation of Melville Peninsula may be concluded with extracts from the notes that I wrote on August 28, 1946, while making a reconnaissance flight in from Foxe Basin, which was left in about latitude 68° 30′ N. Unfortunately no suitable place could be found for a landing to be attempted (*See* also Polunin MS.o). Around Hall Lake, which proved to be of very different shape from the dotted outline on even the latest maps (1943 and 1945), the country was low and predominantly of limestone. But to the west it soon became darker and higher, rising to rounded hills which even from the air appeared near the west coast to have almost the proportion of mountains. Most of the interior, down the centre of which we flew southward from southwest of Hall Lake, consisted of grey, rocky "hogs'-backs" or wider domes and flats intersected by streams and numerous small lakes.

Like Hall Lake, Sarcpa Lake (around latitude 68° 25′ N. and longitude 83° 10′ W.) proved to be free from ice and of entirely different shape from the dotted outline on the maps. To the south, flying down the centre of the peninsula, dark (or sometimes fairly light) grey rocks occupied most of the area, there being relatively few lakes. Dark brown, probably heathy, vegetation

appeared from 5,000 feet to occupy in places as much as one-third of the total area, though usually far less. Persistent snow-patches were fairly numerous, and there were some sizable rivers about which were in several cases wider plains where the darker brown vegetation was more or less continuous over considerable areas—apart from lighter grey-brown tracts that were probably marshy.

Farther to the south the country still continued undulating, of dark grey colour with some lighter patches, and with lakes far less numerous than is usual in such terrain. The vegetation looked for the most part unexpectedly poor; nor was there much sign of the yellowish or greenish lichenous growth that is usually to be seen in such interior regions, but instead a preponderance of greys and browns. This may have been due to the relative proximity of the sea in the west, and the probable direction of the prevailing winds. Toward the 67th parallel lakes became more numerous and sizeable, covering up to about a quarter of the area. Barren-looking grey rock predominated, but there were some fairly extensive, smooth, brownish (or occasionally yellowish brown) vegetated areas on flats around the larger lakes and in other lowland situations.

About Lyon Inlet the coasts looked dark grey and rocky though apparently low, and there seemed to be more vegetation than in the interior to the north; ice-pups were plentiful, and there were some heavier floes to be seen. Vansittart Island looked still better vegetated, especially on its lower southern plains, which appeared to have an almost continuous investment of brownish vegetation.

7. NORTHERNMOST LABRADOR

Very little of Labrador lies north of the 60th parallel, so this is by far the smallest of our districts. It reaches only to a little below 61 degrees north, and stretches from about 64° 10′ W. to 65° 8′ W., comprising in all only a very few hundred square miles. As, moreover, the land in this area has in no place a span of more than a few dozen miles and is relatively uniform in type, if not in local detail, it seems best to treat it as a whole and rather briefly.

The outline of the coast is very irregular, there being numerous indentations and accompanying islets (cf. Forbes 1936, pp. 48-53, including figures,[1] and Miller 1936, map facing p. 56). In the north lie the little Button Islands, and most of the central part is occupied by the larger Killinek Island. McLelan Strait (Grenfell Tickle), which separates this last from the mainland, is narrow and frozen over during much of the year, so affording little in the way of a barrier to plant and animal migration. The mainland regions to the south are continuous with the great bulk of the Labrador Peninsula, although it is only to the south of our southern boundary (60 degrees north) that the mountains become really high[2] and the terrain very rugged (*See* Part IV on these "Sub-arctic Regions"). Almost throughout the part of northern Labrador that lies within our area the topography is, however, quite drastic in its local variations, the physiography being intimate in the extreme. The terrain consists typically of rather small rounded hills of varying (but never great) height—*See* Plates LXXIII and LXXIV. The whole has been intensely glaciated, but is now devoid of ice-fields.

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[1] *See* also Forbes *et al*. 1938, especially photos on pp. 97, 100-102, 142-3, 147-9.

[2] Ikordlearsuk, a northern outpost of Torngat Mountains, is 2,800 feet (853 m.) high and lies just within our area (Abbe 1936, pp. 110 and 116). The regions to the south are particularly well illustrated in the publication of Forbes *et al*. (cf. 1938).

PLATE LXXIII.

Country inland of Port Burwell, taken from a hilltop, and showing the typical, dark, rounded hills of varying height that occupy at least half of the area. In the foreground is a poor, mossy heath. Killinek Island, N. Labrador, Sept. 1, 1934.

PLATE LXXIV

In the foreground, a poorly vegetated marsh. Behind is a lake at the foot of a low, rocky hill. Port Burwell, N. Labrador, Sept. 1, 1934.

GEOLOGY

Fundamentally, the whole of northern Labrador appears to be a rolling peneplain that has been elevated on the Atlantic side and depressed on the Ungava Bay side, although in our area the "undulating lowlands" resulting from this western depression (cf. Abbe 1936) are only to be distinguished in the extreme south (cf. Hitchcock 1936, pp. 56-58). Toward and beyond the southeastern boundary are more mountainous regions whose physiography and geology have been described in some detail by Odell (1938, pp. 187 *et seq.*).

So far as has been determined the bedrock in our area is everywhere of acid-weathering material, chiefly granites and gneisses, with occasional local variants such as the sillimanite schist on Ikordlearsuk (Odell 1938, p. 192). The surface is, however, in many places covered with erratic material, frequently including much limestone. These deposits, many of which in low-lying areas were probably laid down under the sea, are generally thin and localized, the granites and gneisses being visible *in situ* in most places. The erratic materials are so mixed and variable in composition from one small area to the next as frequently to suggest an origin by "ice-rafting". This is the transportation of material from one place to another on floating "bergs" or ice-pans, and is particularly frequent and important in peninsular areas of irregular coastline and strong tides and currents such as the northernmost "tip" of Labrador. It is, of course, only effective around or below sea-level, so erratic deposits found at all far above the line of maximum submergence must result from transportation of the normal kind—chiefly on glaciers.

CLIMATE

Compared with most other districts in our area the climate of northernmost Labrador is maritime in type, although not so markedly as at Resolution Island (*See* above). Thus the following temperature data from Port Burwell (and surely the whole of this comparatively small area belongs to the same general regime) show that the fluctuations are greater than at Resolution Island. Especially is this difference marked in summer, the average monthly means in 1931-4 for June, July, August, and September being 38, 44, 44, and 40 at Port Burwell and only 34*, 39*, 39, and 36 at Resolution Island. The corresponding maxima are, respectively, 58·5, 74, 70, and 56 at Port Burwell and 47, 56, 53, and 46 at Resolution Island. These and other figures speak for themselves, and also show that the summer at Port Burwell is less favourable than at Lake Harbour and some other places in our area. Thus Port Burwell has come to be known among Hudson's Bay Company officials as a very cold and foggy place. It is also a very wet one. Reliable precipitation data have unfortunately not been taken with sufficient regularity for a definite ruling, but it appears that the combined rain and snowfall is at least as great as at Resolution Island in an average year, and may sometimes considerably exceed 20 inches (50·8 cm.), the fall being spread out fairly evenly in the different seasons.

VEGETATION

A fairly detailed account of the vegetation around Port Burwell will be given below. In view of this and of the small size of the present district, as well as of its similarity, by all accounts, in most of the different parts, it seems unnecessary here to quote the rather many cursory references to the plant life of this much visited area. Notable, however, is the persistence of only four species of vascular plants to the exposed summits of Ikordlearsuk: these were *Luzula confusa* (on

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* Average of 3 years only.

Port Burwell, 60° 25′ N., 64° 52′ W. Average 1931-4.

Month	Temperature °F.			Precipitation (often only 1 or 2 years)	
	Maximum	Minimum	Monthly mean	Inches	Snow or rain
January	26	−29	−6	2·3	S
February	36	−27	−6	3·8	S
March	38	−16	6	1·6	S
April	41	−5	20	0·3	S
May	54	8·5	29	1·18	S and a little R
June	58·5	25·5	38	1·6	R and a little S
July[1]	74	30	44	1·71	R
August[1]	70	31	44	2·51	R
September[2]	56	29	40	?4·13	?R
October[2]	45	20	32	?	
November[2]	38	−8	17·5	?	
December[2]	28	−23·5	−4	?	

[1] Temperatures are average of 3 years only.

[2] Temperatures are average of 2 years only.

both summits, as might be expected—cf. Polunin 1938, p. 91), *Cardamine bellidifolia, Poa glauca,* and *Papaver radicatum,* and may be contrasted with the richer flora persisting to similar or even greater altitudes not far to the south (cf. Abbe 1938, pp. 220-224).

Professor David Potter of Clark University, Worcester, Massachusetts, has made two expeditions to various points on the east coast and tells me that the vegetation, of which he is an experienced observer, is there very similar to that developed at Port Burwell—which lies on the west coast though still only a few miles from the Atlantic seaboard. However, around McLelan Strait (Grenfell Tickle), near the southeast corner of our area, some of the communities look more luxuriant than any of those developed in the immediate vicinity of Port Burwell, and there occur several plants that have not been found elsewhere in the entire Canadian Eastern Arctic; farther south still, in the extreme southeast corner, is the entrance to Ekortiarsuk Fiord (c. 60° N.; c. 64° 20′ W.) of which Forbes remarks (in Forbes *et al.* 1938, p. 95), though he was concerned largely with the inland regions just outside the southern boundary of our area, "The contrast between the steep, dark cliffs and the wide, level grasslands in the warm afternoon sunshine was vivid and pleasant; and in the sheltered waters of the fiord we felt that we had come to a singularly favored haven."

On the other hand, the 1,500-foot (457 m.) high and exposed Cape Chidley[1] (latitude 60° 27′ N., longitude 64° 28′ W.), and particularly the much lower Button Islands, are rather poorly vegetated. Professor Potter landed on one of these, called Lacey Island and said to be 825 feet high (Havergal 1915, p. 219, and cf. Smith 1932, p. 26), in about latitude 60° 40′ N., longitude 64° 37′ W., and found that the most advanced community developed there was a *Cassiope* heath. Nevertheless, the majority of the plants that were most common around Port Burwell were also to be found on this island.

Plant Communities Around Port Burwell

Port Burwell lies on the northeast coast of Ungava Bay, in latitude 60° 25′ N., longitude 64° 52′ W., near the western end of Gray Strait about 15 miles from Cape Chidley (Low 1906, p. 7). It is on Killinek Island, but the single strait that starts just south of Port Burwell and separates this island from the

[1] *See* photo given by Forbes (1936, p. 53).

mainland is narrow and with little doubt phytogeographically negligible (*See* above). Port Burwell was discovered and selected as an observation station in 1884, being named after its first white occupant. For a long time it was a Moravian Mission centre and the local headquarters of the Hudson's Bay Company and the R.C.M.P.; also a customs clearance house and an advance base for the Eastern Arctic Patrol. It has probably been more often visited than any other point in our area, at least in recent years, and is the only place from which a plant species (*Stellaria calycantha* (Ledeb.) Bong.=*S. borealis* Bigel.)[1] has been recorded as "just possibly introduced"—*See* Part I, p. 194, and cf. p. 374. The land, which is high to the south and "finally sinks into the sea with the Button Islands", is still very hilly around Port Burwell. Thus in the words of Low (1906, p. 7) "The surrounding country, although low in comparison with that to the southward, is rugged, with steep rocky cliffs, that rise from 100 to 500 feet above the water of the harbour. There is little level ground in the neighbourhood." This is to be seen from Plate LXXIII, taken from a hilltop near Port Burwell and showing how dark and rounded are these hills.

Some account of the weather of this rather cool and very foggy and damp place has been given above. The geology is in conformity with that of the rest of the region. Thus, Bell reports (1884, p. 18DD) "The rock everywhere consists of ordinary varieties of gneiss, the commonest of which are massive reddish and dark hornblendic and micaceous". Overlying the bedrock in many places is glacier-deposited or ice-rafted erratic material of very varying type and origin, being sometimes almost pure limestone whereas at another spot only a few yards away it consists entirely of acid-weathering material (or, at all events, contains nothing that effervesces with HCl in the cold).

Although I have visited Port Burwell no less than seven times, the calls have been too brief (often only a very few hours), or other circumstances have prevented me from making anything like a complete survey of the vegetation. The following account is rather a description, which is often somewhat brief and generalized, of the outstanding plant communities to be met within a few miles of the Hudson's Bay Company's trading post.

(i) HILLS AND STEEP SLOPES

The hills around Port Burwell occupy at least half of the total land area, are comparatively low, and have smooth, rounded summits. In sheltered depressions these summits support closed mossy "heaths", which differ scarcely at all from those developed in the valleys, and which will be described in more detail below. The general, more exposed surfaces and sides of the hills are also most typically vegetated by heaths, but of depauperated kinds much interrupted by "bare" rocks. The chief plants are such ground-shrubs as *Arctostaphylos alpina*, *Vaccinium uliginosum* var. *alpinum*, *Salix arctica*, and *S. uva-ursi*, and they are associated with grassy and other herbs (especially *Cardamine bellidifolia* f. *laxa*, *Carex misandra*, *Festuca brachyphylla*, *Hierochloe alpina*, *Luzula confusa*, *Poa arctica*, *Stellaria longipes*, and Drabae) to form mats wherever the substratum allows.

The chief "binder" in exposed situations is the silvery grey moss *Rhacomitrium lanuginosum*, and it may also act as a pioneer, spreading over the rock surface and allowing higher plants that can root in its luxuriant mat to colonize

[1] *Stellaria calycantha* (Ledeb.) Bongard in Mém. Acad. Imp. Sci. St. Pétersb. Sér. VI, II, p. 127, 1833 (*S. borealis* Bigel.—*See* Fernald 1940, pp. 254 *et seq.*).

the area. Such light-coloured mats of this moss are seen occupying ledges in the centre of Plate XCII (p. 231), which shows the side of a typical small rocky hill in this district. The luxuriance of the mosses, which are often more in evidence than lichens even on exposed summits, is doubtless a corollary of the damp and foggy climate. However, on the actual rock faces, which are usually intact and smooth, lichens are the chief or only denizens and more or less cover the surface. The following appear to be the most important lichens playing this part:

Buellia atrata
Caloplaca elegans
C. sorediata
Cladonia pyxidata var. *pachyphyllina*
Gyrophora cylindrica var. *delisei*
G. torrefacta
Haematomma ventosum var. *lapponicum*
Lecanora alpina
L. intricata
L. polytropa var. *leucococca*
Lecidea armeniaca
L. lapicida f. *ecrustacea*
L. pantherina var. *achariana*
L. speirea
L. tesselata
Ochrolechia frigida
Parmelia alpicola
P. saxatilis
Rhizocarpon badioatrum
R. geographicum
Sphaerophorus fragilis
Sporastatia cinerea

Ledges covered with mineral material, and crevices or depressions in these rocks, afford a roothold for various "open soil" species, among which the following are the most typical and constant:

Arenaria rubella
Campanula uniflora
Carex nardina
Cystopteris fragilis
Diapensia lapponica
Draba alpina var. *nana*
D. nivalis
Dryas integrifolia
Juncus biglumis[1]
Sagina intermedia
Saxifraga aizoides[2]
S. cernua
S. nivalis var. *tenuis*
S. oppositifolia incl. apprg. f. *pulvinata*
Sedum rosea[3]
Silene acaulis var. *exscapa*

The majority of these species reach high latitudes, and many of them occupy similar habitats, away from competition, in the British Isles (cf. Polunin 1939b, pp. 271-3). The more extensive patches of closed vegetation in these most exposed rocky areas generally consist of cryptogamous "heath" of *Rhacomitrium lanuginosum* and Cladoniae, dominated by *Salix uva-ursi* or some similar dwarf, with associated *Hierochloe alpina* but often little else.

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[1] In damp depressions.
[2] Only where some grains of limestone are to be found.
[3] On the subject of this rendering, *See* Sprague in Jour. Bot., LXXVII, p. 126 (1939).

Many of the hills, especially the lower ones, around Port Burwell are covered with transported erratic material. That this is very variable in composition from place to place, and may often have been rafted on ice-pans or 'bergs', has already been stated above. A preliminary to this ice-rafting is suggested by Bell, who writes (1884, pp. 23-24DD) "Some tolerably thick ice still remained attached to the shore at high tide-mark. During the melting of the snow on the hills above it, torrents had carried a quantity of stones and earth out of an adjacent bank and deposited them upon the surface of the ice. The connection between this ice and the shore being sufficiently weakened, the next spring-tide would carry it out to sea, as previous tides had already carried parts of the adjoining ice, similarly laden", or again (1885, p. 7DD), about the end of June "the ice began to leave the adjoining shores, after having received upon its surface more or less rocky debris from the crumbling cliffs and slopes, or from having had earthy matter incorporated in it by freezing and by the action of high tides, such as those of Ungava Bay. . . ." It is easy to visualize how, in this manner and by other agencies, not only inanimate matter but occasionally living disseminules or even whole plants could be received by sea-ice and ultimately transported. And although the vast majority doubtless perish in the sea, there must be some that find their way to the shore and help to distribute the species; a single viable seed in a millennium will suffice. In this connection it should be remarked that considerable movement of ice westward from Davis Strait into Hudson Strait has been noted, although on the south side of the latter the flow is said to be only to the east (cf. Smith 1932, p. 5).

Not infrequently these transported deposits of erratic material at Port Burwell are highly calcareous; a typical example on one exposed hilltop, where the soil was light coloured and effervesced violently with HCl, the reaction being slightly basic (pH 7·2), supported the following interesting list of angiosperms growing in open formation and all rather dwarfed (*See* Plate LXXV):

Dryas integrifolia	a-va
Carex nardina	f-a
C. glacialis	f
Saxifraga aizoides	f
S. oppositifolia apprg. f. *pulvinata*	f
Carex misandra	o-f
Koenigia islandica ? (seedlings)	l
Polygonum viviparum	o
Salix calcicola	o
S. reticulata	o
Silene acaulis var. *exscapa*	o
Vaccinium uliginosum var. *alpinum*	o
Arctostaphylos alpina	o
Astragalus alpinus	r
Braya purpurascens	r
Kobresia simpliciuscula	r
Luzula nivalis	r
Oxytropis terrae-novae	r
Sedum rosea	r
Cerastium alpinum	vr
Eutrema edwardsii	vr
Pedicularis flammea ?	vr
Puccinellia vahliana	vr

Except beneath the larger patches of the *Dryas*, the soil of this "half-barren" was almost devoid of humus. The cryptogams, like the angiosperms, were of poor growth, mosses being largely limited to small tufts of *Drepanocladus*

uncinatus and a sterile *Bryum*—both generally confined to the *Dryas* matlets. Lichens were more numerous, though again far from luxuriant, the following being all fairly frequent:

Bacidia alpina
Caloplaca subolivacea
Candelariella placodizans
Cetraria cucullata
C. nivalis
Lecanora epibryon
Lecidea ramulosa
Pertusaria coriacea
Physcia muscigena
Thamnolia vermicularis

The hillsides are generally vegetated by one or other of the communities found on summits and brows. A noticeable feature of most of the steeper rocky slopes is the frequency of ledges covered with conspicuous light-coloured mats of such mosses as, especially, *Rhacomitrium lanuginosum* (*See* above, and cf. Plate XCII).

PLATE LXXV

Dryas "half-barren" with many associated phanerogams on erratic calcareous deposit covering hilltop. Port Burwell, N. Labrador, Sept. 24, 1934.

(ii) VALLEYS

Although the hills are nowhere high, definitely low-lying terrain covers rather a small proportion of the total land area around Port Burwell. As on the hills, the substratum is variable in type and composition; for although the bedrock is everywhere of massive granite or gneiss, there are erratic deposits and raised beaches in many places. These may include some limestone. The local conditions of aspect, drainage, shelter, snow-covering, etc., also vary within wide limits—often drastically in closely contiguous areas of this changeable terrain.

A result is that the vegetation is variable and patchy in the extreme. Thus, almost all of the communities of the hills, including those described above, are to be found in the valleys, where there are also others too numerous to mention, besides those described later under "Marshes" and "Snow effect". Perhaps most typical of all, and covering considerable areas in favourably sheltered situations (though rarely extending far without interruption by some other facies or entirely different community), is the ordinary mixed heath to be found on slopes and well-drained flats.

The chief dominants in this mixed heath of the more luxuriant type are *Empetrum nigrum* var. *hermaphroditum*, *Vaccinium uliginosum* var. *alpinum*, *V. vitis-idaea* var. *minor*, and various Salices. These dominants are generally much mixed and changeable in different examples, frequently varying also from one square metre to the next in the same example, even where the habitat conditions appear identical. They are associated with various herbs, of which the most characteristic include *Antennaria angustata*, *Carex bigelowii*, *C. scirpoidea*, *Juncus trifidus*, *Hierochloe odorata*, *Lycopodium selago*, *Potentilla crantzii* and *Pyrola grandiflora*. In a few places *Anemone parviflora* and *Campanula rotundifolia* s.l. are of some ecological importance in this community, where *Salix cordifolia* var. *callicarpaea* may show a tendency toward bush formation, although no true scrub has been observed in the vicinity. Indeed, the highest plants around Port Burwell appear to be grasses, which in favourable places attain 45 cm. in height, and in the case of *Calamagrostis canadensis* var. *scabra* may considerably exceed this.

A 4-metre quadrat in a typical area of mixed heath in a valley a few miles southeast of Port Burwell gave the following list, the growth of the dominants being so luxuriant that there was little room for associated angiosperms of less strong competitive powers:

Empetrum nigrum var. *hermaphroditum*	lvad
Vaccinium uliginosum var. *alpinum* (incl. f. *langeanum*)	lvad
V. vitis-idaea var. *minor*	acod
Salix reticulata	acod
S. arctica (chiefly var. *kophophylla*)	f
S. uva-ursi	f
Carex bigelowii	o-f
Arctostaphylos alpina	l
Carex scirpoidea	o
Polygonum viviparum	o
Pyrola grandiflora	o
Salix herbacea	o
Carex rupestris	r
Dryas integrifolia	r
Lycopodium selago	r
Poa arctica	r
Pedicularis flammea	vr
Salix cordifolia var. *macounii*	vr
Cardamine bellidifolia f. *laxa*	(1)
Draba alpina	(1)

The snow-covering here appeared to be considerable and beneficial although not too long-lasting. The soil beneath the surface 5 cm. of litter and cryptogams was of sandy gravel and slightly stained with humus to a depth of about 25 cm., at which level there was some suggestion of a darker "pan". In reaction the soil was slightly but distinctly acid (generally about pH 6·0). Cryptogams formed a luxuriant investment, in some places mixed with and binding the dominants, in others slightly below them. Mosses predominated, especially *Rhacomitrium lanuginosum*, and included relatively hygrophytic species not

only in damp depressions, but also binding the axes of the normal heath, where they were probably indicative of the damp climate of the region. Lichens, although less important as "fillers", were numerous and much in evidence in some places—especially where open patches occurred in the otherwise continuous heath and a luxuriant "reindeer-moss" sward was apt to be developed. The most ecologically important or significant cryptogams in the above quadrat were as follows:

BRYOPHYTA	*Rhacomitrium lanuginosum*	vasubd
	Aulacomnium turgidum	
	Bartramia ithyphylla	
	Dicranum groenlandicum	
	Drepanocladus uncinatus	
	Encalypta rhabdocarpa	
	Hylocomium splendens	
	Odontoschisma macounii	
	Philonotis tomentella	
	Polytrichum norvegicum	
	Tortula norvegica	
LICHENES	*Alectoria ochroleuca*	
	Cetraria crispa[1]	
	C. cucullata	
	C. delisei[1]	
	C. nivalis	
	Cladonia amaurocraea	
	C. coccifera var. *stemmatina*[1]	
	C. elongata	
	C. lepidota f. *stricta*	
	C. mitis	
	C. uncialis	
	Dactylina arctica	
	Ochrolechia frigida	
	Peltigera sp.	
	Psoroma hypnorum	
	Sphaerophorus globosus	
	Stereocaulon alpinum	
FUNGI	*Calvatia cretacea*	
	Omphalia umbellifera	
	Puccinia bistortae on *Polygonum viviparum*	
	Rhytisma salicinum on *Salix herbacea*	
	Ustilago inflorescentiae on *Polygonum viviparum*	

Several additional Fungi are evident in such areas in the autumn—especially the hitherto undescribed *Cudoniella muscorum*, and *Cintractia caricis* on various species of *Carex*.

(iii) MARSHES

As a result of the intricately changing physiography, the marshes around Port Burwell are of small extent in spite of the damp climate. Marshy areas of one sort or another are, however, very numerous in the valleys and very variable in type and composition. Except for the rarity of *Arctagrostis latifolia* and the apparent absence of *Carex aquatilis* var. *stans*, the chief component phanerogams are much the same as in southern Baffin, viz., various species of *Eriophorum* (especially *E. angustifolium* and *E. scheuchzeri*), *Dupontia fisheri*, *Salix arctophila*, *Carex membranacea*, *C. rariflora*, etc.—also in places *Juncus arcticus* and *J. castaneus*. However, the typically associated vascular plants include not merely the usual *Cardamine pratensis* var. *angustifolia*, *Carex bipartita*, *Equisetum arvense*, *E. variegatum*, *Juncus albescens* and *J. biglumis*, *Luzula nivalis*, *Lychnis apetala*, *Polygonum viviparum*, *Saxifraga stellaris* var.

[1] Record inadvertently omitted from Part II of the present series.

comosa, Tofieldia pusilla (T. borealis), etc., but also in places such "southern" types as *Cardamine pratensis* var. *palustris, Deschampsia alpina*, and *Potentilla palustris*.

Two 2-metre quadrats taken at random in a typical area of marsh gave the following composite list of vascular plants:

Carex rariflora	vad
C. membranacea	acod
Eriophorum angustifolium	f-lacod
Polygonum viviparum	o-a
Salix herbacea	absent-la
Calamagrostis neglecta var. *borealis*	absent-la
Salix arctophila	f
Juncus albescens	r-f
Eriophorum spissum	o
E. callitrix	absent-o
Carex bipartita	r
Juncus castaneus	r
Cardamine pratensis var. *angustifolia*	absent-r
Pedicularis flammea	vr
Saxifraga stellaris var. *comosa*	vr

It is noticeable that, although the two quadrats were only a few metres apart, the composition in the two cases, except for the dominant, was very different—hence the discrepancies in frequency degrees and the number of local absentees. Occupying almost the whole of the area between the axes of these higher plants, and forming a rather smooth mat, were a mixed assemblage of mosses of luxuriant growth. This mat being waterlogged almost to the surface, and apparently sodden throughout the summer, the feet sank into it for several centimetres. As might be expected, lichens were generally absent although several Fungi occurred—as I already noted on my first visit to this place in 1931. The following were the chief mosses in the quadrats listed, the Fungi that are added being all that could be seen on these or immediately surrounding areas:

MUSCI	*Aulacomnium palustre*
	Calliergon sarmentosum
	C. stramineum
	Drepanocladus revolvens[1]
	D. uncinatus
	Haplodon wormskjoldii[1]
	Meesea triquetra[1]
	M. uliginosa
	Paludella squarrosa
	Sphagnum teres
FUNGI[2]	*Cintractia caricis* on *Carex bipartita*
	Cortinarius fasciatus
	Hygrophorus miniatus
	Omphalia umbellifera
	Peronospora septentrionalis on *Cerastium cerastoides*[3]
	Rhytisma salicinum on *Salix arctophila*
	Ustilago inflorescentiae on *Polygonum viviparum*

The soil was dark and "squishy" to a depth of at least 30 cm., being penetrated by the roots of the dominants to about 25 cm. In reaction it appeared to be slightly acid, although the pH could not be determined owing to adulteration of the only available bottle of indicator. It certainly lacked any calcareous matter, being composed of humus mixed with fine silt, which failed to effervesce with strong acid.

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[1] Burwell record inadvertently omitted from Part II, but the species reported from nearby.

[2] Not all within the quadrats.

[3] *See* footnote (1) on page 196.

(iv) SNOW EFFECT

Owing to the very changeable physiography, the snow-drift and late-melting areas around Port Burwell are in several senses variable and "jumbled", although numerous and well marked on account of the heaviness of the snowfall and the exposed situation of most surrounding areas. Indeed many of the narrower valleys hold deep coverings all winter and tend almost throughout to take on a late-snow aspect in their flora and vegetation, as is evidenced by the occurrence almost everywhere in them of such species as *Cassiope hypnoides, Erigeron unalaschkensis, Parnassia kotzebuei, Sibbaldia procumbens,* and *Taraxacum lapponicum.* The margin of one ravine-like valley, in the angle between its bed and steep rocky side, is seen in Plate LXXVI. Here the snow probably drifts more deeply and certainly melts later than elsewhere in the valley, for the aspect is to the north, and the community is of *Salix herbacea* (tiny rounded leaves) with associated *Taraxacum lapponicum* (large rosettes and pale flowers), *Veronica alpina, Epilobium anagallidifolium,* etc.

PLATE LXXVI

"Late-snow" margin of valley whose rocky side is seen above. The area is dominated by *Salix herbacea* (tiny, rounded leaves), with much *Taraxacum lapponicum* (large rosettes with pale flowers). Port Burwell, N. Labrador, Sept. 1, 1934.

In a few places where large and lasting drifts occur, the zones are to be seen with reasonable clarity. Frequently they are five in number, and generally they follow much the same sequence as similar patches in Baffin (*See* above), the chief differences lying in the local rarity of *Cassiope tetragona* and in the number of "southern" associates, several of which are entirely unknown to the north.

Most notable among these relatively temperate species are *Cerastium cerastoides*,[1] *Draba crassifolia, Epilobium anagallidifolium, Equisetum scirpoides, Gnaphalium supinum, Parnassia kotzebuei, Sagina saginoides*, and *Veronica alpina* (including var. *unalaschkensis*).

A typical sequence of the zoned subclimaxes may be stated briefly as follows:

Zone I. A fairly luxuriant mixed heath, generally dominated by *Vaccinium uliginosum* var. *alpinum* (in the absence of *Cassiope tetragona*) with associated *Dryas integrifolia*, and with *Cassiope hypnoides* and much *Salix herbacea* as indicators of a good and long lasting snow-covering, which so shortens the growing-season that the usual dominants are greatly weakened. The pH may be as low as 5·6.

Zone II. A dwarfed zone where the snow melts too late to allow the usual dominants to complete their life-processes in a normal summer, with the result that the very diminutive *Cassiope hypnoides* is usually dominant, with much associated *Salix herbacea* and *Sibbaldia procumbens*—also, frequently, *Arabis alpina, Erigeron unalaschkensis, Juncus trifidus, Poa alpina*, and *Polygonum viviparum*. The pH is here noticeably higher than in zone I.

Zone III. A well-marked *Salix herbacea* zone in which this covers most of the area (cf. Plate LXXVI), the most characteristic associates being such herbs as *Arenaria sajanensis, Cerastium cerastoides, Epilobium anagallidifolium, Ranunculus pygmaeus, Taraxacum lapponicum*, and *Veronica alpina*. Grey "crumbler" lichens and *Solorina crocea* persist, but bryophytes now form most of the cryptogamic investment. The pH is here constantly high whatever the substratum (6·4 and 6·6 in the examples tested).

Zone IV. A "mossy" zone characterized by the liverwort *Gymnomitrium corallioides* and such "open soil" herbs as *Cerastium alpinum, Luzula confusa*, and *Oxyria digyna*.

Zone V. A herb "barren" of *Phippsia (Catabrosa) algida* and a few of the quickest flowering denizens of surrounding areas. This is rarely developed except in narrow ravines that are largely filled with snow in winter.

Zone III is perhaps the most characteristic and extensive of all. For comparison with other areas, and to indicate the complexity of its flora in the absence of any tall and rank dominant, the following list from a 5-metre quadrat may with advantage be given:

Salix herbacea	vad
Gnaphalium supinum	la
**Polygonum viviparum*	f
**Arenaria sajanensis*	o-f
Carex bipartita	o
**Carex membranacea*	o
**Cerastium cerastoides*	o
Equisetum arvense	o
Oxyria digyna	o
Poa alpina	o
P. arctica	o
Ranunculus pygmaeus	o
Erigeron unalaschkensis	o (1)
**Taraxacum lapponicum*	o
Trisetum spicatum var. *maidenii*	o

[1] This is the correct rendering, Linnaeus's original publication (Sp. Pl., ed. 1, p. 422, 1753, sub nom. *Stellaria*) being so spelled, though Britton (in *Mem. Torrey Bot. Club*, *V*, p. 150, 1894) indeed wrote "cerastioides" when first publishing the combination under *Cerastium*.

* For explanation see next page.

Cassiope hypnoides	r
**Epilobium anagallidifolium*	r
Luzula confusa	r
Ranunculus nivalis	r
Saxifraga cernua	r
**S. rivularis*	r
Sibbaldia procumbens	r
Taraxacum torngatense ?	r
Veronica alpina	r
Cardamine pratensis var.	vr
**Draba alpina*	vr
Deschampsia alpina	(1)
Pedicularis flammea	(1)
Potentilla hyparctica f. *tardinix* (*P. emarginata* f. *tardinix*)	(1)

Species marked '*' were to be seen in flower on the area of this quadrat on September 25, 1936.[1] It lay on a light slope of northerly aspect beneath a steep and rocky hillside, and the whole area appeared smooth and green, the plants being all either dwarfed or naturally small. *Salix herbacea* was overwhelmingly dominant, forming with its associates a close mat almost everywhere; nevertheless, a number of bryophytes of poor growth were to be found, the most notable being *Bartramia ithyphylla*, *Brachythecium albicans*, *Bryum turbinatum*,[2] *Dicranoweisia crispula*, *Drepanocladus uncinatus*, *Gymnomitrium corallioides*, *Philonotis tomentella*, and *Polytrichum norvegicum*. Lichens were little in evidence, except for many small squamules of one or two terricolous species, but several Fungi occurred—particularly *Calvatia cretacea* and *Omphalia umbellifera* on the ground, and *Ustilago vinosa* parasitizing *Oxyria digyna*. The mat of *Salix herbacea*, etc., was pressed flat against the surface of the ground. Underlying it was 1 cm. of dark humous soil, and beneath this was grey clay or fine silt containing little or no humus. The whole was kept constantly damp by percolation from a (probably perennial) patch of snow higher up the slopes.

(v) FRESHWATER

With the damp climate, non-porous bedrock, and very changeable terrain, freshwater habitats are numerous and variable around Port Burwell, although generally of small extent. A few of the outstanding examples will now be briefly described.

Many small freshwater streams persist throughout the summer, their beds, where stony, having typically a brown or greenish investment of mosses, with or without such Algae as *Chaetomorpha* sp. and long tassels of *Stichococcus subtilis*. Where the current is slower and the bed is of mud, brownish investments containing numerous microscopic forms occur. The following were the most noticeable in two samples taken in late July, 1936, from one stream, which at that time was by no means slow:

Closterium moniliferum	va
Cosmarium botrytis	a
Caloneis silicula var. *alpina*	
Ceratoneis arcus	
Chamaesiphon incrustans[3]	
Cosmarium botrytis var. *mediolaeve*	
C. crenatum f. *boldtianum*	
C. meneghinii	
C. notabile	

[1] Cf. p. 171.

[2] The record of this species from Port Burwell was inadvertently omitted from Part II, page 427.

[3] Epiphytic on *Chaetomorpha* sp.—cf. Part II, page 27.

C. pyramidatum
C. ralfsii
C. speciosum
Cymbella botellus
C. scotica var. *naviculacea*
C. stauroneiformis
C. ventricosa var. *genuina*
Diatomella balfouriana
Diploneis oblongella var. *oblongella*
Eunotia pectinalis var. *minor*
E. praerupta var. *genuina*
E. septentrionalis
Frustulia vulgaris
Gomphonema micropus
G. mustela
G. parvulum
Meridion circulare
Navicula radiosa var. *genuina*
N. viridula var. *genuina* and var. *slesvicensis*
Nitzschia denticula
Pinnularia subcapitata var. *stauroneiformis*
P. viridis var. *commutata*
Staurastrum acarides
S. dilatatum
S. pyramidatum
Stauroneis anceps var. *amphicephala*
S. smithii
Synedra ulna var. *genuina*
Tabellaria fenestrata
T. flocculosa

The following were especially characteristic of seepage from rocks, all except the last named (which was hitherto undescribed) being apt to be very plentiful in such situations, which abound in the district:

Cosmarium obtusatum
Microspora stagnorum
Penium cylindrus
Prasiola crispa
Sphaerella nivalis
Staurastrum gratum

The *Prasiola* is also characteristic of, and especially luxuriant on, trampled and manured areas around habitations—as elsewhere in our area.

Around the margins of tarns and pools the algal life is also abundant, especially in late summer. The following, which like the longer of the two lists above include the Diatomeae, were identified from two small samples taken from different, rather peaty pools early in the last week of July, 1936—long before "late summer" in this region:

Aphanothece stagnina
Caloneis silicula var. *alpina*
Chroococcus turgidus
Cosmarium annulatum
C. cyclicum var. *arcticum*
C. cymatopleurum
C. hammeri var. *protuberans*
C. plicatum
C. pycnochondrum
C. subcrenatum
C. undulatum var. *minutum*
Cyclotella antiqua
Cymbella angustata var. *hybrida* and var. *linearis*
C. cistula var. *maculata*
C. cuspidata

C. gastroides
C. scotica var. *incerta*
C. stauroneiformis
C. subaequalis var. *oblonga*
C. turgida
C. ventricosa var. *genuina* and var. *semicircularis*
Denticula tenuis var. *intermedia* and var. *mesolepta*
Diatomella balfouriana
Diploneis oblongella var. *ovalis*
Euastrum binale
E. dubium var. *snowdoniense*
Eunotia curvata
E. praerupta var. *genuina*
Fragilaria pinnata
Frustulia rhomboides var. *crassinervia*
Gomphonema angustatum var. *productum*
G. mustela
G. parvulum
Meridion circulare
Navicula bacilliformis
N. cincta var. *angusta*
N. lanceolata
N. perpusilla
N. radiosa var. *genuina*
N. rotaeana
Neidium affine var. *capitatum* and var. *undulatum*
N. longiceps
Nitzschia amphibia
N. amphioxys
N. denticula
N. frustulum
N. palea
Nostoc commune
N. sphaericum
Pinnularia cleveana
P. cuneata
P. divergentissima var. *hustedtiana*
P. globiceps var. *krookii*
P. lata var. *minor*
P. microstauron
P. pulchra
P. spitsbergensis
P. viridis var. *clevei*
Scytonema myochrous
Staurastrum clepsydra var. *sibiricum*
S. crenulatum
S. dickiei
S. inornatum
S. muticum
S. spongiosum
Stauroneis anceps var. *amphicephala*
S. phoenicenteron var. *amphilepta*
Stigonema turfaceum
Synedra ulna var. *amphirhyncus*
Tabellaria flocculosa

Hereabouts are also to be found such aquatic mosses as *Calliergon giganteum* var. *fluitans,* which may form large, dark brown beds, and, in a few lakes, *Ranunculus trichophyllus* var. *eradicatus* and *Hippuris vulgaris*. *Ranunculus hyperboreus* and *Equisetum arvense* may also grow as aquatics in shallow water, the latter being then remarkably attenuated. Where the bottom is of mud and the situation fairly shallow, *Eriophorum angustifolium* may grow out to form luxuriant beds, although in exposed situations, at least on the leeward side, a turfy "hard line" of matted roots and humus is more frequently developed, as

in the north (cf. pp. 93-4). Rocky, uncolonized shores are very frequent and muddy ones not rare; the latter, like many damp depressions in marshes, may support large colonies of *Nostoc commune* or other common Cyanophyceae, or, more rarely, of *Lyngbya aerugineo-caerulea*.

(vi) STRAND AND MARINE

The shores are in most places of smoothed rock or sheer cliff supporting only such diminutive or chasmophytic Algae as grinding ice will allow. However, in a few places small pebbly or sandy beaches occur and support the usual beds of *Elymus arenarius* var. *villosus*, with or without *Mertensia maritima* var. *tenella* and *Arenaria peploides*. *Festuca rubra* var. *arenaria* is especially plentiful higher up on such shores.

In some more muddy situations small areas of diminutive saltmarsh are to be found, dominated by the usual *Puccinellia phryganodes*. The most characteristic associates are much as in southern Baffin, viz., *Carex bipartita* var. *amphigena*, *C. salina* apprg. var. *subspathacea*, *Cochlearia officinalis* vars., *Koenigia islandica*, *Potentilla egedii* apprg. var. *groenlandica*, and *Stellaria humifusa*. These areas of saltmarsh are best developed around the shores of brackish lagoons in sheltered situations, where they have the form of a dense sward—principally composed of matted roots and stolons of the dominant *Puccinellia*. Typical Algae in these brackish or tidal lagoons are as follows:

Cladophora arcta
Desmarestia aculeata
Dictyosiphon foeniculaceus
Enteromorpha ramulosa
Pylaiella littoralis
Rhizoclonium hieroglyphicum[1]
R. riparium var. *implexum*
Ulothrix flacca
U. speciosa

In all but the most exposed places, rocks and boulders around high tide-mark support small Algae, which may form an almost continuous investment. The chief plants in one such association were *Pylaiella littoralis*, *Rhizoclonium riparium* var. *implexum*, *Ulothrix laetevirens*,[2] and *U. speciosa*—also much *Lyngbya nordgardii* on the *Rhizoclonium*. Between tide-marks[3] the rocks may be festooned with Algae in sheltered situations, the dominant here being the familiar *Fucus vesiculosus*, or sometimes, very locally, *Ascophyllum nodosum*.

Lower down, where codfish abound (they are known farther north in our area only in the extreme southeast of Baffin), fine beds of large *Laminaria saccharina* and *Alaria esculenta* are to be seen, with associated *Rhodymenia palmata* and doubtless a host of other brown and red Algae, as well as several large Chlorophyceae.

(8) NORTHERN QUEBEC

The part of the mainland of Quebec that lies north of the 60th parallel of latitude has an area of some 50,000 square miles and extends to latitude 62° 36′ N. It stretches meridionally from about 69° 12′ W. to 78° 33′ W., being

[1] Abundant in a freshwater stream running through a brackish mudflat that appeared to be covered by the highest tides.
[2] The record of this species from Port Burwell was inadvertently omitted from Part II, p. 47.
[3] According to Smith (1932, p. 4) the tidal range (average perigean springs) at Port Burwell is 22 feet, mean neaps being 10½ feet.

roughly semicircular in outline and thus affording a well consolidated unit for our consideration, even the coastline being less complicatedly indented than most of those dealt with previously.

The eastern shore bordering on Ungava Bay has numerous small islands, the water being shallow there. The coast is comparatively low, the rocky hills rarely exceeding 300 feet (91 m.) in altitude, although they may be double this height only a few miles inland (cf. Low 1899, pp. 19-21L). The north coast, which forms much of the south shore of Hudson Strait, is about 300 feet high at Cape Hopes Advance, its eastern end. Thereafter it rises to the west, continuing with increased loftiness and boldness to Cape Wolstenholme in the extreme northwest, where the cliffs are said to be nearly 2,000 feet high (cf. Havergal 1915, pp. 9 and 244, and Bethune 1935, p. 16).[1] To the south, the west coast quickly falls to a low level, which is maintained until our southern boundary is passed (cf. Havergal 1915, pp. 9 and 244).

Inland the country constitutes a plateau of no great height, dissected by numerous lakes and rivers and consisting for the most part of "rolling country in which the differences of elevation rarely exceed 350 to 500 feet, and the higher elevations do not exceed 2,500 feet above sea level" (Bethune 1935, p. 16). In the words of Havergal (1915, p. 9) "The country seems unfinished, as if it had been left as a specimen to show what other countries may have been at the termination of the glacial epoch, when the rivers had not worn down their beds, and valleys and basins had not been formed". Although the hills are rounded and all areas appear to have been intensely glaciated, no major ice-cap occurs here or anywhere else on the "Ungava Peninsula" at the present time.

GEOLOGY

Although from the geologist's point of view the rocks, according to Low (1899, p. 30L), "present many interesting and complex problems," the geology in broad outline is comparatively simple. The bedrock almost everywhere is of Laurentian gneiss or fine-grained granite (cf. also Bell 1884 and 1885). However, around Payne Bay in the extreme southeast corner, and again at and inland of Cape Smith (latitude 60° 42′ N., on the west coast), there are extensive outcrops of Precambrian age—cf. Bethune 1935, map at end—particularly ferruginous sediments and dark diabase. Up to 350 feet (107 m.) almost everywhere, and to 600 or even 700 feet in some places, the surface is veneered with rewashed glacial material, which may form fairly extensive beds. Particles of shell and erratic limestone frequently introduce a little "lime" to such areas, especially near sea-level, but otherwise there are no calcareous deposits known[2] in the region in spite of the extensive limestone islands that occur both to the east and to the west.

CLIMATE

Meteorological data over a period of years are available only from Cape Hopes Advance, situated in the angle between Hudson Strait and Ungava Bay and forming the northeast corner of the district. The following data from this place indicate a climate rather closely comparable with that of Lake Harbour, which lies not so far away on the other side of Hudson Strait. Thus the two places have a similar growing-season of about 4 months (cf. p. 132), and a similar total

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[1] The height marked on the latest (1945) maps is, however, only 1,260 feet.

[2] An exception may be the light-coloured patch noted from the air in 1946 on the north bank of Payne River about longitude 71° W. *See* Polunin, MS.o, notwithstanding Low (1899, p. 21L).

precipitation of something over 14 inches (35·5 cm.) in an average year. However, as might be expected from the more exposed position of Cape Hopes Advance, its climate is on the whole less continental and favourable than that of Lake Harbour, having less high temperatures in summer and rarely a single month without frost, although the precipitation is more definitely concentrated into the summer months (cf. p. 132).

It seems probable that conditions to the west and inland tend to be more favourable than at Cape Hopes Advance, but that they are unfavourable again, and perhaps even poorer, around Cape Wolstenholme (*See* below). Certain it is that on the west coast south of our area, e.g., at Port Harrison (to be described in Part IV of the present series) and especially at Fort George (*See* Connor 1930, p. 11), the summer becomes warmer and warmer.

Cape Hope Advance, 61° 3′ N., 69° 37′ W. Average 1931-33.

Month	Temperature °F			Precipitation	
	Maximum	Minimum	Monthly mean	Inches	Snow or rain
January	19	−30	− 9	0·22	S
February	19	−33	−10	0·29	S
March	26	−20	2	0·96	S
April	34	− 9	14	1·48	S and a little R
May	38	7	26	0·98	S and R
June	52	24	34	1·77	R and a little S
July	71	28	42	1·72	R
August	66	32	43	1·49	R
September	54	27	36	2·84	R and a little S
October[1]	36	16	27·5	1·64	S and a little R
November[1]	29·5	− 3·5	16	0·87	S
December[1]	26·5	−21	− 1·5	0·44	S

[1] Average 1931–2 only.

VEGETATION

On the east coast south of Cape Hopes Advance, conditions and the attendant vegetation appear to be rather poor. Near the sea the land is "generally low and flat, broken only by occasional ridges of rocky hills never more than 300 feet high" (Low 1899, p. 20L). From all accounts that I have heard it would seem to be unusually barren for a mainland coast at this latitude, although doubtless the flora is considerable. Around Payne Bay (latitude 60° 2′ N.), according to verbally imparted information from Mr. C. H. Ney of the Canadian Geodetic Service, the vegetation is fairly luxuriant in the valleys but sparse on the rocky ridges of the hinterland, except in depressions. The plant collection that Mr. Ney and his assistant Joe Courtright made for me there in early August 1936 is just the kind of collection that could be made on ordinary (i.e., not the most favourable and sheltered) areas of similarly acid-weathering rocks at Lake Harbour. Although occasional specimens of *Betula glandulosa* var. *sibirica* or *Salix cordifolia* var. *callicarpaea* may rise a few inches above the surface of the ground, no scrub is to be seen near the Ungava Bay coast at Payne Bay. On the other hand, well inland, where the rocky hills "rise to about 600 feet farther up the river....the climate....appears to be more moderate than on the open seacoast as willows grow to bushes several feet high" (according to Smith 1932, p. 35).

Along the north coast, starting in the east at Diana Bay near Cape Hopes Advance, the country and vegetation are somewhat better known. As I have already reported (1937a, p. 112) "The vast majority of the 74 species [of vascular plants] recorded....from Diana Bay occur also at Wakeham Bay and on Baffin Island, but several appear to be absent from Akpatok Island. Nearly all are arctic-alpines of circumpolar distribution but a few are of restricted range.... With regard to the general country at the head of Diana Bay....Mr. Ney reports that broken rocky slopes about 200 feet high rise up right from the water's edge in most places, and that these rocks are igneous and darker than at most other points he has visited. Concerning the hinterland Mr. Knapp [*in litt.*] writes that growth is generally very stunted, even the willows in the more sheltered valleys rarely rising more than a foot above the surface of the ground, and.... 'of all the many hundreds of miles I have travelled in the Arctic, I have not yet met the place so rich in lichen as this. The meadows stretch for acres uninterrupted by rock, and clothed with deep rich lichen with the usual grass growing up between. There is mile upon mile of them—dry, rich sandy soil clothed with moss and lichen. The richness and abundance of the lichen more than the moss is simply wonderful; a reindeer herd would go for years here without want'." On the whole, conditions and vegetation at Diana Bay appear to be similar to those at Payne Bay, even if the rocks are rather darker and growth slightly more luxuriant at the head of the former, which lies some 18 miles back from Hudson Strait.

To the west, around Whitley Bay and Joy Bay, the hills are considerably higher (Low 1899, p. 16L) but otherwise conditions appear to be similar. Lawson's report (1888, pp. 207-212) concerning the closely adjacent Stupart Bay (latitude 61° 35′ N., longitude 71° 35′ W.) is rather disappointing from our point of view, although to judge from the flora and his "Tabulated Observations" the vegetation would appear to be relatively luxuriant. Lawson reports (1888, p. 209) that hereabouts ripe seed is produced in abundance by many species, and that leaves of *Cassiope tetragona, Ledum* and *Vaccinium vitis-idaea* when well protected may remain green all the winter (*ibid.*, p. 211).

A few miles to the west of here, surrounded by still higher and more rugged hills, is the sheltered Wakeham Bay, whose terrain and rather luxuriant vegetation will be described in detail below. So far as I have had an opportunity of determining, from written or verbal reports or from my own observations, the vegetation thereafter for nearly 150 miles westward is similarly luxuriant in sheltered inlets, although the exposed coast and higher hills may be relatively barren. Of Douglas Harbour in King George Sound (latitude 61° 55′ N., longitude 72° 37′ W.), Low (1899, facing p. 8L) gives two significant photographs, and remarks that near the head of the inlet where hills rise abruptly to 1,500 feet "the press was filled with arctic flowering plants which formed a brilliant carpet over the sandy and gravelly terraces in a continuation of the valley...". However, from an 1,860-foot (567 m.) vantage point Low observed (1899, p. 9L) that "The view from the summit is very desolate. Barren, rocky or boulder-covered hills on all sides, run in low rounded ridges separated from one another by small deep valleys filled with snow; the surface, wherever there is sufficient soil, was covered with lichens diversified with a few arctic flowers, but not in the beautiful abundance met with in the valleys".

In Sugluk Inlet I had the pleasure of spending a day in the vicinity of the Hudson's Bay Company post (latitude 62° 15′ N., longitude 75° 30′ W.) during the Canadian Eastern Arctic Expedition of 1936. Here the hills are locally less

high than to the east and west. The fundamental rocks are grey and reddish gneisses penetrated by a few narrow dykes and veins, most frequently of quartz, but the lowlands and side-hills are often covered with rewashed glacial material of mixed origin, including some calcareous fragments. The marine terraces and slopes of the hills look an almost continuous velvety green in late July, due to vegetation, which forms a luxuriant carpet almost everywhere except on exposed hilltops and crags where the gneisses remain bare and show grey and relatively barren. The flora and vegetation appeared very similar to those of Wakeham Bay, which belongs to the same general region and climatic regime, and which will be described in detail later. The most obvious or notable differences were (1) the usual replacement of blue-flowered *Oxytropis terrae-novae*, so plentiful at Wakeham Bay, by the more widespread, yellow-flowered *O. maydelliana*, which was much parasitized by *Uromyces lapponicus* and *Rhabdospora oxytropidis*, and (2) the comparative rarity of *Ledum palustre* var. *decumbens* and greater frequency of *Betula glandulosa* var. *sibirica*. These differences are probably unimportant, the plant communities being for the most part almost identical with those of Wakeham Bay—not only in their type and dominance but also in the more typical associates. Even the tallest willows, which formed a scrub in sheltered depressions and on some of the most favourable south-facing slopes, were of much the same height (50-60 cm.) as at Wakeham Bay. Again, similar "flower slopes" were noted in the two places as at Wolstenholme (*See* below), and the same observation was made in all these three places that vegetation tended to develop earlier each year on the hills than in the valleys—probably owing to the relative lack of snow-covering on all raised areas.

The vegetation of Sugluk may with advantage be illustrated by the following four photographs. Plate LXXVII is a general view showing the low and gently undulating countryside just around the post. In the foreground is a broad stream[1] and at its side well vegetated, meadow-like slopes supporting many willows. Plate LXXVIII shows an unusually large clump of *Dryopteris fragrans* on a dry outcrop of gneiss. In the foreground is *Poa arctica*, a typical component of the herb stage of the xerosere, and *Arnica alpina*—both of them with flowering axes on the left. The rock face is largely covered with lichens. Plate LXXIX is of a typical area of marsh dominated by luxuriant tussocks of *Eriophorum spissum*, with associated *Arctagrostis latifolia*, *Dupontia fisheri*, *Salix arctophila*, and Carices. Plate LXXX shows a late-snow gulch with tall scrub willows clothing the top of the slopes (especially on the south-facing side, to the left) and below, grassy-sedgy associations with many forbs—including some *Primula stricta* and, just in the run-off in the foreground, *Arabis alpina* in flower. In the centre of the gulch is a luxuriant, dark moss mat.

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[1] The following freshwater diatoms were identified from a small sample of deposit including "green filamentous Algae, etc." taken from gently flowing water at Sugluk on the last day of July, 1936:

Cyclotella antiqua
Cymbella angustata var. *hybrida*
C. botellus
C. heteropleura var. *minor*
C. microcephala
C. scotica var. *incerta*
C. stauroneiformis
Denticula tenuis var. *intermedia*
Eunotia curvata
E. fallax var. *gracillima*
E. monodon
E. pectinalis var. *minor*
E. praerupta var. *genuina*
Gomphonema micropus
G. mustela
Navicula subtilissima
N. variabilis var. *gomphonemacea*
N. zellensis var. *linearis*
Neidium bisulcatum
Nitzschia frustulum
Pinnularia borealis
P. divergens var. *genuina*
P. divergentissima var. *hustedtiana*
P. hudsonensis
P. mesogongyla
P. spitsbergensis
P. streptoraphe
P. sublinearis
Stauroneis anceps var. *amphicephala*
S. obtusa
S. perpusilla var. *obtusiuscula*
Stephanodiscus astraea
Tabellaria fenestrata
T. flocculosa

Plate LXXVII

General view of typical, rather gently undulating terrain supporting abundant continuous vegetation. The slopes near the stream in the foreground are especially luxuriant and meadow-like, but include some low "scrub" willows. Sugluk, N. Quebec, July 31, 1936.

Plate LXXVIII

Dryopteris fragrans on rock outcrop. Leaves of *Arnica alpina* and *Poa arctica* are seen in the foreground, and, on the extreme left, flowering axes of both species. Note the mass of withered fronds of the fern; the rock is elsewhere largely covered with lichens. Sugluk, N. Quebec, July 31, 1936.

PLATE LXXIX

Eriophorum spissum dominating luxuriant marsh. Between its tussocks are seen many rank grasses and Carices, and much creeping *Salix arctophila*. Sugluk, N. Quebec, July 31, 1936.

PLATE LXXX

Late-snow gulch with luxuriant, shrubby willows 50 cm. high clothing upper levels, and grassy-sedgy slopes below. In the central run-off is a dark moss mat and, in the foreground, flowering *Arabis alpina*. Sugluk, N. Quebec, July 31, 1936.

Around Cape Wolstenholme, as will be described in detail below, the vegetation is noticeably poorer than in some at least of the central parts of the north coast that have been mentioned above. Nor does the nearby Digges Island, which "consists of bare hills of gneiss, rising to a height of about 500 feet," sound particularly inviting, though "The hills are intersected by broad valleys, carpeted with moss and coarse grass" (according to Markham 1888, p. 658).

Much of the west coast of Ungava to the south of Cape Wolstenholme also appears to be rather poorly vegetated, although there can be no doubt that more luxuriant communities occur in the most favourably sheltered situations inland. Thus Bell (1885, p. 12DD) reports of the environs of "Hyla", about 20 miles south of Cape Wolstenholme, that "Viewed from a distance, these hills and mountains have a naked appearance, but in walking over the country itself, the grasses and sedges, and a variety of Arctic plants which grow around the ponds and lakes, and in sheltered places among the hills, give the landscape a pleasantly green appearance in many places. No shrubs are to be seen except the creeping willows, but the Eskimo make mats for the floors of their summer tents by fastening together, in regular order, twigs of dwarf birch, (*Betula glandulosa*, Michx.) about three feet long, which we understood they obtained in the interior."

Farther south than this, near Cape Smith (latitude 60° 42′ N., longitude 78° 33′ W.), I was able to land on one occasion, although only for a short afternoon. Here I was assured by a previous visitor that it was "the most barren place in Hudson Bay", and by the local white resident that there was "absolutely no vegetation"; and certainly the general aspect was bleak and unpromising, even when viewed with powerful binoculars from a few hundred metres offshore. Cape Smith is very exposed, being situated on an island, which is indeed rather poorly vegetated—at least compared with the adjacent mainland where the land, especially to the south and thence eastwards, is comparatively low. Even if closed higher vegetation at Cape Smith is confined to rather occasional patches of limited extent, generally in sheltered depressions, the flora is large and interesting, for here I found such plants as *Antennaria tweedsmuirii*, *Bostrychonema alpestre*,[1] *Carex microglochin*, *C. saxatilis* var. *miliaris*, *Chrysomyxa empetri*,[2] *Festuca vivipara* var. *hirsuta*, *Habenaria obtusata* var. *collectanea*, *Luzula sudetica*, *Potamogeton filiformis* and var. *borealis*, *Primula egaliksensis* and *P. stricta*, *Rutstroemia poluninii*,[3] *Staurastrum compactum*, and phases of *Tanacetum huronense*. Several of these are not known to occur elsewhere in our area. Moreover, this list of "new species" and "rarities" could doubtless be extended[4] considerably in even one full working day; it merely gives an indication of the richness of the botanical harvest to be expected in this little known region.

At Cape Smith the fundamental rock is a dark grey or blackish diabase, which is often rendered reddish by iron on weathering. The shores in places are composed of mixed material probably of glacial origin, and it was here that most of the interesting plants were found (there was no time to explore the interior, which was rocky and mostly rather low) and the only extensive patches of closed vegetation were seen.

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[1] Parasitic on *Polygonum viviparum*.
[2] Parasitic on *Empetrum nigrum* var. *hermaphroditum*.
[3] Parasitic on stems of *Equisetum arvense*.
[4] Thus, no attempt was made to investigate or even collect the bryophytes and lichens at this place.

Some of these patches of closed vegetation were of a heathy nature, some marshy, and some of mixed forbs and grasses; in almost all there occurred willows, although the tallest of these were occasional isolated specimens of *Salix cordifolia* var. *callicarpaea* that reached 30 or 35 cm. in height. The only peculiar communities encountered during my brief visit to this place were (1) an aquatic (slightly brackish?) one developed in shallow tarns near the shore and consisting of dense beds of *Potamogeton filiformis*, with abundant associated *Hippuris vulgaris* and in places much *Eleocharis acicularis* f. *submersa*, *Pleuropogon sabinii*, and *Ranunculus trichophyllus* var. *eradicatus*,[1] and (2) an open one (on otherwise bare, rocky slopes) characterized by *Dryopteris fragrans*, *Epilobium latifolium*, *Hierochloe alpina*, and *Saxifraga tricuspidata*, all these being of good growth.

Southward of Cape Smith, for 120 miles to Cape Dufferin, which lies outside our area, "The Coast......is in the form of a bay and much more broken; it is a low fenny marsh, with little tufts here and there" (according to Havergal 1915, p. 247). Not so very much farther south again, "Clumps of trees, consisting of spruce and tamarac of fair size, grasses, sedges, and a variety of vegetation are found at the mouth of Little Whale River. Potatoes have also been grown as an experiment, and a variety of plants used for salad grow well there" (Baird 1920, p. 13). Inland, to the east, the forest extends farther north, in the manner described in Part IV of this series; but it does not attain the 60th parallel of latitude anywhere in Quebec (contrary to the indications on the map given by Anderson—1935, p. 68), and, consequently, it is not to be dealt with in the present treatise.

During the summer of 1946 I had several opportunities of observing from the air the vegetationally unknown interior of northern Ungava, and detailed work was carried out at three landing points. Two of these points (Chimo and Gregory Lake) were south of the 60th parallel and will be described in "Part IV, Subarctic Regions," together with my aerial observations of the vegetation in this belt. The other point, although lying in latitude 60° 16′ N. and longitude 70° 58′ W. on what it is proposed to name McGill Lake, for reasons of space and the time taken to determine specimens will also be described in Part IV. Suffice it here to say that although this point was near the southern boundary of our area, and well inland, the vegetation was extremely poor. The country was undulating, with usually rounded hills rising at most a few hundred feet from a general altitude of about 900 feet (275 m.), and on the whole was quite astonishingly barren. The flora was limited and plant growth almost everywhere depauperate, with no proper scrub. Lakes and tarns accounted for perhaps a third of the total area, and barren, grey, rocky hills or fields of loose boulders for nearly another quarter, the remainder being made up of flattish plains or more gently domed, raised gravelly tracts that from a distance looked tolerably well vegetated. However, on investigation the plains proved to be occupied by thin marshes in damp places and scanty, lichenous heaths or polygon-interrupted detrital fields in drier areas; where the vegetation was continuous it was thin and composed largely of lichens of relatively poor nutritive value (especially species of *Alectoria*).

This McGill Lake district appeared to be of truly arctic type, in spite of its low latitude: thus although *Ledum palustre* var. *decumbens* was plentiful and *Betula glandulosa* var. *sibirica* occurred, the most characteristic ground-shrub was *Cassiope tetragona*. Succulent herbs were few and of poor growth,

[1] The record of this plant from Cape Smith is unfortunately omitted from Part I of the present series, p. 210.

as were grasses and even sedges apart from such hardy types as *Hierochloe alpina, Eriophorum angustifolium, Carex bigelowii,* and *Luzula confusa.* Except in some marshy and heathy areas to the south, the soil around McGill Lake was thin and the vegetation as a whole had taken so little "hold" of the surface that it seemed best to describe it in terms of habitats rather than plant communities (as in the case of the nearby Akpatok Island, *See* Polunin 1934 and 1935). The following were the main types distinguished and investigated around McGill Lake: gravelly or sandy flats and banks, rocky "barrens" and boulder-fields, mixed heathy areas, polygon soils, marshy depressions, lakes and streams and their margins, late-snow areas and surrounding zones. Examples of all these were to be seen in almost any small tract of country, and between them accounted for practically the whole of this disappointing region.

To the south of McGill Lake the banks of Payne River, around latitude 60° N., although generally steep and rocky appeared to be much better vegetated, with what looked from the air to be quite luxuriant willow scrub. However, on the surrounding plateau the vegetation appeared poor, though generally domes of small hills had their sides yellowish and the tops darker to almost sooty-black with Alectorias, etc.

To the northwest and north-northwest of McGill Lake the vegetation appeared slightly better than around it, though the terrain looked in general similar. Something like a quarter of the area was occupied by lakes, and a half by "barrens" or else yellowish green or sooty-looking, probably lichenous heaths. The remainder was of grey rock or boulder-fields, or brown vegetated areas that appeared to be marshy and here occupied more of the area than for some distance to the south. Flying northward it was noted that in about latitude 60° 38′ N. and longitude 71° 25′ W. there was a rather sudden change to more interesting looking country with less standing water but fine green tracts of, probably, willow scrub along the frequent streams and rivers. The valleys here were wide and open, with extensive tracts of brownish, marshy or heathy vegetation.

The vicinity of an unnamed lake in about 60° 40′ N. and 71° 37′ W. showed a return to the lighter grey and relatively barren, McGill Lake type of terrain. It was strewn with boulders, with often much bedrock visible *in situ,* and over very considerable tracts appeared to lack anything approaching continuous vegetation. The lakes were often ice-bound and snow-patches large and numerous hereabouts even in August, becoming more so towards the north-east, nearer the coast, where the country looked predominantly grey and rocky, and far more hilly. The lakes appeared deep and, in the sun, took on an almost Mediterranean tinge of blue.

Inland of Burgoyne Bay (latitude 61° 15′ N., longitude 71° 35′ W.), similar grey rocky terrain prevailed that lacked continuous vegetation except over limited tracts in occasional sheltered, brown marshy depressions or still narrower, mossy ledges in favourable situations. Lichens, at least of the lighter hues, were markedly less in evidence than inland—presumably owing to the damper climate near the coast. To the northwest was still more rugged country, especially around Joy Bay, Wakeham Bay, and Douglas Harbour (*See* above), where luxuriant scrub vegetation was to be seen on the gentler, lower slopes and stream-side flats and alluvial delta "cones" in sheltered valleys running in from the coast and evidently near sea-level. Inland of here, even on the uplands, there were some goodly tracts of brownish or greenish vegetation developed in many of the more favourable, sheltered situations in the undulating

and otherwise light-coloured, gravelly, bouldery, or clay plains, and even around exposed hilltops some smaller colonized tracts were to be seen, with long and conspicuous solifluction "streaks" extending down the gentler slopes. The dark strips appeared to be covered and at least partly stabilized by vegetation, the lighter ones that separated them being probably still dynamic.

To the northwest, towards Cape Weggs (latitude 62° 29′ N., longitude 73° 43′ W.), the country looked grey, bouldery, and relatively barren. Snow-patches were plentiful even in August and the domed hills showed fine solifluction streaks extending out and downwards from near their summits—radiating from a more or less central point, which was the actual summit. On flatter areas were visible polygons of various sorts and sizes, including elongated ones on slight slopes, which, indeed, exhibited every conceivable gradation to solifluction streaks; only in the most favourable, lowland situations was the vegetation at all extensive and luxuriant. However, it was notably so in some fine and deep but open valleys over which we flew, cut by goodly streams, where the rocks looked peculiarly light coloured.

Payne Lake in the centre of northern Ungava is now known to lie entirely south of the 60th parallel, but still far north of the limit of tree growth (*See* Part IV), and as my only air traverse of the country to its north and northwest was made in bad weather, when most of the terrain was obscured by cloud, only a few notes can be given. Much of what country was visible appeared to be grey and rocky and relatively barren, though with more light yellow due to lichens than nearer the coast. Rarely did it appear that less than one-third of the area was occupied by lakes or surrounding dark depressions, and much of the rest was of raised, flattish "tops." In places the country looked more broken and rocky, in places undulating and lichen-rich, but for the most part it seemed to be relatively flat and featureless about the centre of the northernmost part of Ungava Peninsula, where grey bouldery terrain or light-coloured lichens predominated. About the larger rivers, such as the North Payne and Povungnituk, lakes were fewer and there tended to be smooth slopes and hummocky domes supporting more luxuriant vegetation than was to be found in the rocky surroundings. Polygons were to be seen on the highish plateau, where vegetation looked rather poor except for occasional fairly extensive brown (apparently heathy) tracts; but in some river valleys, where tributaries entered and the alluvial tracts were wide and open, I thought I could see coppices of luxuriant willow scrub.

To the south of Sugluk and onwards to Cape Wolstenholme (latitude 62° 35′ N., longitude 77° 30′ W.) the country was high and dark, but with rather many snow-patches even in the second half of August. Except on rocky outcrops and the taller hills, which were grey and largely barren, the vegetation was brownish and looked almost continuous. Fine bright green scrub was visible in some of the more sheltered valleys. But then again, inland of Cape Wolstenholme the high, exposed country was rather barren looking. The western Digges Island, too, appeared rocky and poorly vegetated—of scoured and rather low, rounded hills.

Plant Communities Around Wakeham Bay "Post"

Wakeham Bay is a rather deep and narrow inlet on the southern shore of Hudson Strait, almost opposite Lake Harbour. The Eskimo settlement and trading centre, in the vicinity of which the following observations were made, lies in latitude 61° 36′ N., longitude 71° 57′ W., some 6½ miles from the mouth

of the inlet. The local physiography as well as the shoreline is here comparatively rugged, there being frequent hills with rather steep sides and rounded tops, often 1,200-1,500 feet high (cf. Low 1899, pp. 12-13L, and Smith 1932, pp. 40-41).

The fundamental rocks are various gneisses and granites, with several repeated bands of garnetiferous gneiss and dark schist containing nodules of quartz. In places many bands of mica schist appear, giving terrain that reminded me of the "glimmerskiffer" of Nordreisa in Troms Fylke, in the north of Norway, and quartzite forms the summits of some of the hills. The lowlands, and hillsides up to at least 700 feet (213 m.), are largely covered with glacial material that has been rewashed by marine agencies. These deposits, especially low down near the sea, often contain limestone particles and also a considerable abundance of marine shells, whose rapid disintegration when they are brought to the surface may considerably increase the $CaCO_3$ content of the resulting soil.

(i) HILLS AND UPLANDS

Unlike the valleys and lower slopes, which from a distance in early summer look softly verdant and almost continuously vegetated, most uplands although rounded in outline appear grey and largely barren. However, on investigation, different upland areas are seen to vary considerably, not only in exposure but also in their geological and physico-chemical make-up, and, accordingly, in the local development of the vegetation. This may be closed in places, and over limited tracts quite comparable in luxuriance with the vegetation of the lowlands; it may also be earlier in its seasonal development,[1] probably owing to the lack of snow-covering on all raised prominences. As far as my limited investigations in the district have shown, most of the plants that are of general occurrence in the lowlands can persist on the hills to at least 750 feet; those met, in most cases over and over again, in one short walk above this altitude included *Antennaria* spp., *Armeria labradorica, Astragalus alpinus* and *A. eucosmus, Campanula uniflora, Cystopteris fragilis, Eutrema edwardsii, Potentilla nivea, Oxytropis terrae-novae,* and *Vaccinium vitis-idaea* var. *minor.*

The flat summit of one hill, slightly over 1,000 feet (305 m.) in altitude, was of rock and some comminuted material, supporting a sparsely open community of the following mixed (but chiefly far-northern and xeromorphic) angiosperms:

Salix arctica	f
Carex nardina	o
Hierochloe alpina	o
Luzula confusa	o
Papaver radicatum	o
Polygonum viviparum	o
Saxifraga oppositifolia	o
Silene acaulis var. *exscapa*	o
Arenaria rubella	r-o
Cassiope tetragona[2]	vl
Diapensia lapponica	r
Draba nivalis	r
Dryas integrifolia	r
Poa arctica	r
Arctostaphylos alpina	vr
Carex bigelowii	vr
Pedicularis hirsuta	vr
P. lanata	(1)

[1] Thus on July 29, 1936, *Oxytropis terrae-novae* had some big, half-ripe fruits and no longer any flowers on one ridge 800 feet above sea-level, whereas down by the sea it was almost all still in flower.

[2] Parasitized by *Exobasidium vaccinii* var. *myrtilli.*

This list was taken from one area about 8 m. square. Here lichens were numerous and several mosses occurred, although most were of poor growth; these cryptogams included *Polytrichum alpinum, Rhacomitrium lanuginosum, Dactylina arctica, Haematomma ventosum* var. *lapponicum,* and *Stereocaulon alpinum.*

In sheltered depressions and crevices, however small, cryptogams were immediately more luxuriant—especially the *Rhacomitrium,* which here formed quite dense mats that sometimes attained a thickness of 15 cm. and appeared remarkably retentive of water. Frequently Cetrariae and Cladoniae and the liverwort *Chandonanthus setiformis* grew in the *Rhacomitrium,* such a cryptogamous carpet in places "paving the way" for a rather poor *Dryas* or *Cassiope tetragona* "heath" in which were to be found such plants as *Carex rupestris, Cerastium alpinum, Eutrema edwardsii, Luzula nivalis, Potentilla hyparctica* var. *elatior (P. emarginata), Pyrola grandiflora* (leaves only), and *Salix herbacea*—also *Thamnolia vermicularis* whose characteristic loose squamules appeared to have been blown from the surrounding exposed areas.

(ii) LOWLANDS

Unlike even the most favourable stations in the Arctic Archipelago to the north, the lowlands and sides of most hills around Wakeham Bay are rendered a soft, velvety green by an almost continuous covering of vegetation. Apart from the marshes, snow-patches, etc., described below, three main types of vegetation appear to be involved, each having its series of facies and intermediate stages.

I. The first to be encountered by most travellers will be the much mixed and generally lichen-rich, *Dryas* etc. mat developed, for example, on relatively recent beaches of rewashed glacial material that slope back gently from the shores and may extend into the valleys. Except for very occasional projecting stones or boulders, the vegetation is completely closed. Though everywhere possessed of grits and particles of shale, the soil beneath is dark and humous to a depth of 5-10 cm. Lower down it is almost entirely mineral. A 4-metre quadrat taken at random in a typical area had the following composition:

SPERMATOPHYTA	*Dryas integrifolia*	vad
	Carex rupestris[1]	va
	Polygonum viviparum[2]	f
	Salix arctica[3]	f
	S. reticulata[3]	f
	Astragalus alpinus	o-f
	Carex misandra	o-f
	Luzula nivalis	o-f
	Poa arctica	l
	Cerastium alpinum	o
	Euphrasia arctica var. *minutissima*	o
	Oxytropis terrae-novae	o
	Papaver radicatum	o
	Pedicularis lanata	o
	Silene acaulis var. *exscapa*	o
	Vaccinium uliginosum var. *alpinum*[4]	o
	Antennaria angustata	r
	Arenaria rubella	r

[1] Occasionally parasitized by *Schizonella melanogramma.*
[2] Parasitized by *Bostrychonema alpestre* and *Ustilago inflorescentiae.*
[3] Frequently parasitized by *Melampsora bigelowii.*
[4] Small green berries here on July 30, 1936. The majority of associated species were still to be found in flower. According to my field notebooks the plants were frequently parasitized by *Exobasidium vaccinii-uliginosi*—*See* Part II, footnote (1) on page 274.

Carex williamsii ?	r
Epilobium latifolium	r
Luzula confusa	r
Rhododendron lapponicum	r
Saxifraga oppositifolia	r
Arenaria uliginosa	vr (2)
Arctostaphylos alpina	(1)
Lychnis apetala	(1)

The dominant *Dryas* was of good growth and covered about half the area. The diminutive *Carex rupestris*, although abundant everywhere, acted merely as a filler. With a number of other plants quite frequent, including some of fair size, there was little room for cryptogams, although rather many occurred. Generally they were of poor growth, and hardly ever did any one species form a patch more than 5 cm. in diameter. The chief mosses were *Bryum pendulum, Polytrichum alpinum,* and *Tetraplodon mnioides,* but lichens were far more numerouus and important—especially Cetrariae (above all *C. nivalis,* suggesting a poor snow-covering and, with *Carex rupestris,* imparting in places a yellowish grey tinge to the terrain), small Cladoniae, and *Sphaerophorus globosus.*

II. On older and more stabilized, especially rocky, areas, a dry lichen-rich heath is frequently developed in the lowlands, and in sheltered places may even be encountered quite high up in the hills. The dominance is generally far from pure, the community being considerably mixed, although closed. On a rough slope of grey mica schist, faulted about 20 degrees and with frequent longitudinal outcrops dissecting the heath into strips, the composition of one small area was as follows:

VASCULARES	*Cassiope tetragona*	acod
	Ledum palustre var. *decumbens*	acod
	Hierochloe alpina	f-lva
	Vaccinium vitis-idaea var. *minor*	a
	Carex bigelowii	f
	Empetrum nigrum var. *hermaphroditum*	f
	Calamagrostis canadensis var. *scabra* (leaves only)	l
	Pyrola grandiflora (leaves only)	l
	Luzula confusa	o
	Salix herbacea	o
	Vaccinium uliginosum var. *alpinum*	o
	Diapensia lapponica	r
	Lycopodium selago	r
	Silene acaulis var. *exscapa*	r
	Cardamine bellidifolia	vr
	Luzula nivalis	vr
	Pedicularis lapponica	vr
BRYOPHYTA	**Andreaea rupestris*	
	Aulacomnium palustre	
	A. turgidum	
	Chandonanthus setiformis	
	Dicranum fuscescens	
	Polytrichum juniperinum	
	Ptilidium ciliare	
	Rhacomitrium lanuginosum	
LICHENES	*Alectoria ochroleuca*	
	**Buellia atrata*	
	Cetraria cucullata	
	C. glauca	
	C. islandica	
	C. nivalis	
	Cladonia amaurocraea	
	C. mitis	
	C. rangiferina	
	Dactylina arctica	

* For explanation see next page.

	**Gyrophora hyperborea* **G. proboscidea* **Haematomma ventosum* var. *lapponicum* *Ochrolechia frigida* **Parmelia alpicola* **P. centrifuga* **P. pubescens* *Peltigera aphthosa* **Rhizocarpon chionophilum* **R. geographicum* **R. jamtlandicum* *Sphaerophorus fragilis* *S. globosus* *Stereocaulon alpinum*
Fungi	*Bovista plumbea* *Exobasidium vaccinii* var. *myrtilli* on *Cassiope tetragona* *Lycoperdon polymorphum*

The most abundant cryptogams are *Dicranum fuscescens* and *Rhacomitrium lanuginosum* among the mosses, and *Alectoria ochroleuca, Cetraria cucullata, Cladonia mitis,* and *Ochrolechia frigida* among the lichens, which are much more in evidence. Indeed, lichens in places occupy nearly half the surface area of the heath. The outcrops of mica schist are so raised that the entire terrain from a distance looks grey and barren. The rock face supports only cryptogams, those marked '*' in the above list being the most characteristic of this microhabitat, to which indeed the vast majority so marked are confined.

Plate LXXXI

Dense heath dominated by ***Vaccinium uliginosum*** var. ***alpinum*** (tiny, dark leaves), with some ***Salix reticulata*** (large leaves in triads) and light-coloured Cetrariae. To the left of the knife blade is seen a bushlet of ***Rhododendron lapponicum*** in flower. Wakeham Bay, N. Quebec, July 29, 1936.

Plate LXXXI shows an area of heath in which *Vaccinium uliginosum* var. *alpinum* (tiny dark leaves) is dominant. In the mat that it forms are seen some larger leaves (generally in triads) of *Salix reticulata,* and many squamules of light-coloured Cetrariae *(C. nivalis* and *C. cucullata).* To the left of the blade of the sheath-knife is seen a bushlet of *Rhododendron lapponicum,* flowering profusely.

III. In sheltered depressions and on some favourable, south-facing slopes—especially where weathering is rapid and soil more abundant at the broken ends of layered and faulted rocks—there tends to be developed the most luxuriant vegetation of the neighbourhood. This is a tangled willow scrub from 50 to 80 cm. high, dominated by *Salix cordifolia* var. *callicarpaea.* Where the scrub is thickest there is much litter and generally few associates except tall *Calamagrostis canadensis* var. *scabra,* and such rank "underherbs" as *Draba glabella* (generally a tall etiolated form approaching var. *orthocarpa), Potentilla hyparctica* var. *elatior* (*P. emarginata*), and *Ranunculus pedatifidus* var. *leiocarpus* (frequently parasitized by *Puccinia ranunculi,* for which it is a "new" host). Such a scrub is seen in the foreground of Plate LXXXII, taken on a scarp and showing how well vegetated is the general countryside. However, where the scrub is interrupted and seepage, snow-patch, rock outcrop, earthen scar, or other habitats offer "fresh possibilities", the flora may be considerable; and indeed it is on these favourable, south-facing slopes that a large proportion of the "rarities" of the district are found.

Plate LXXXII

Tall (70 cm.) scrub of *Salix cordifolia* var. *callicarpaea* on scarp of southerly aspect. The valley and hill beyond are almost continuously vegetated. Wakeham Bay, N. Quebec, July 29, 1936.

Besides its function as an associate in the last two communities described, *Calamagrostis canadensis* var. *scabra* frequently forms a characteristic community of its own. This is a conspicuous, waving sward up to nearly a metre in

height that is developed locally in sunny, well-drained lowland situations—generally on sandy protuberances or heaps of boulders. An example is seen in Plate LXXXIII, where the surrounding area, which is probably part of a "snow-patch", is darkened by tufts of *Cassiope tetragona*.

PLATE LXXXIII

Calamagrostis canadensis var. *scabra* forming a characteristic sward nearly a metre high on heap of boulders. The moraine in the background is vegetated by a poor (late-snow?) heath showing dark tufts of *Cassiope tetragona*. Wakeham Bay, N. Quebec, July 29, 1936.

At the very head of Wakeham Bay, about 10 miles from the area investigated, the willows I am told by previous white residents grow "about ten feet tall, upright, with stems as thick as a man's ankle". The "reindeer-moss" sward, which around the post does not exceed 6 cm. in height, is said to reach 5 inches (12·7 cm.) at the head of the bay and farther inland.

(iii) MARSHES

Marshy areas are variable but generally of small extent in the vicinity. The chief plants are *Eriophorum angustifolium*, *E. scheuchzeri*, *Carex membranacea*, *C. rariflora*, *Scirpus caespitosus* var. *callosus*, *Dupontia fisheri* var. *aristata*, and *Arctagrostis latifolia*—any one or more of which are usually dominant and the rest present. Other vascular plants that are characteristic of these marshes and attained some degree of ecological importance in one or other of the observed examples of them are: *Cardamine pratensis* var. *angustifolia*, *Carex aquatilis* var. *stans*, *C. norvegica* (*C. halleri*), *C. holostoma*, *C. atrofusca*, *Equisetum variegatum*, *Eriophorum spissum*, *Hierochloe pauciflora*, *Juncus albescens*, *J. biglumis*, *J. castaneus*, *Polygonum viviparum*, *Rubus chamaemorus*, *Salix arctica*,[1] *Saxifraga hirculus*, *S. stellaris* var. *comosa*, and *Tofieldia pusilla*

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[1] Frequently parasitized by *Melampsora bigelowii*.

(T. borealis). The composition and dominants change from one spot to another in the most confusing manner, and so does the luxuriance of the associated cryptogams. Most often these last form a continuous mat of mosses with few or no lichens, and their luxuriance in some places appears to be increased by pasturing and manuring by wildfowl; this mat is typically of many mixed species, which in one small area included the following:

*[1]*Aulacomnium palustre*
* *A. turgidum*
[1]*Calliergon sarmentosum*
[1]*C. stramineum*
Cinclidium subrotundum
Dicranum bonjeanii
*[1]*D. groenlandicum*
Ditrichum flexicaule
Drepanocladus aduncus
[1]*D. revolvens*
Meesea triquetra
M. uliginosa
[1]*Oncophorus wahlenbergii*
Orthothecium chryseum
Polytrichum commune
*[1]*P. juniperinum*
*[1]*Sphagnum capillaceum* var. *tenellum*
S. compactum
S. lindbergii
[1]*S. squarrosum*

The species marked '1' were especially plentiful. Sphagna were more numerous than almost anywhere that I have seen to the north in these meridians, and, with *Dicranum groenlandicum* and Aulacomnia, frequently assisted in the formation of tussocks. On these tussocks grew, particularly, the mosses marked ' * ' in the above list, and also the following six angiosperms and four lichens:

Cassiope tetragona
Ledum palustre var. *decumbens*
Pedicularis hirsuta
Rubus chamaemorus
Vaccinium uliginosum var. *alpinum*
V. vitis-idaea var. *minor*
Cetraria nivalis
Ochrolechia frigida
O. inaequatula
Sphaerophorus globosus

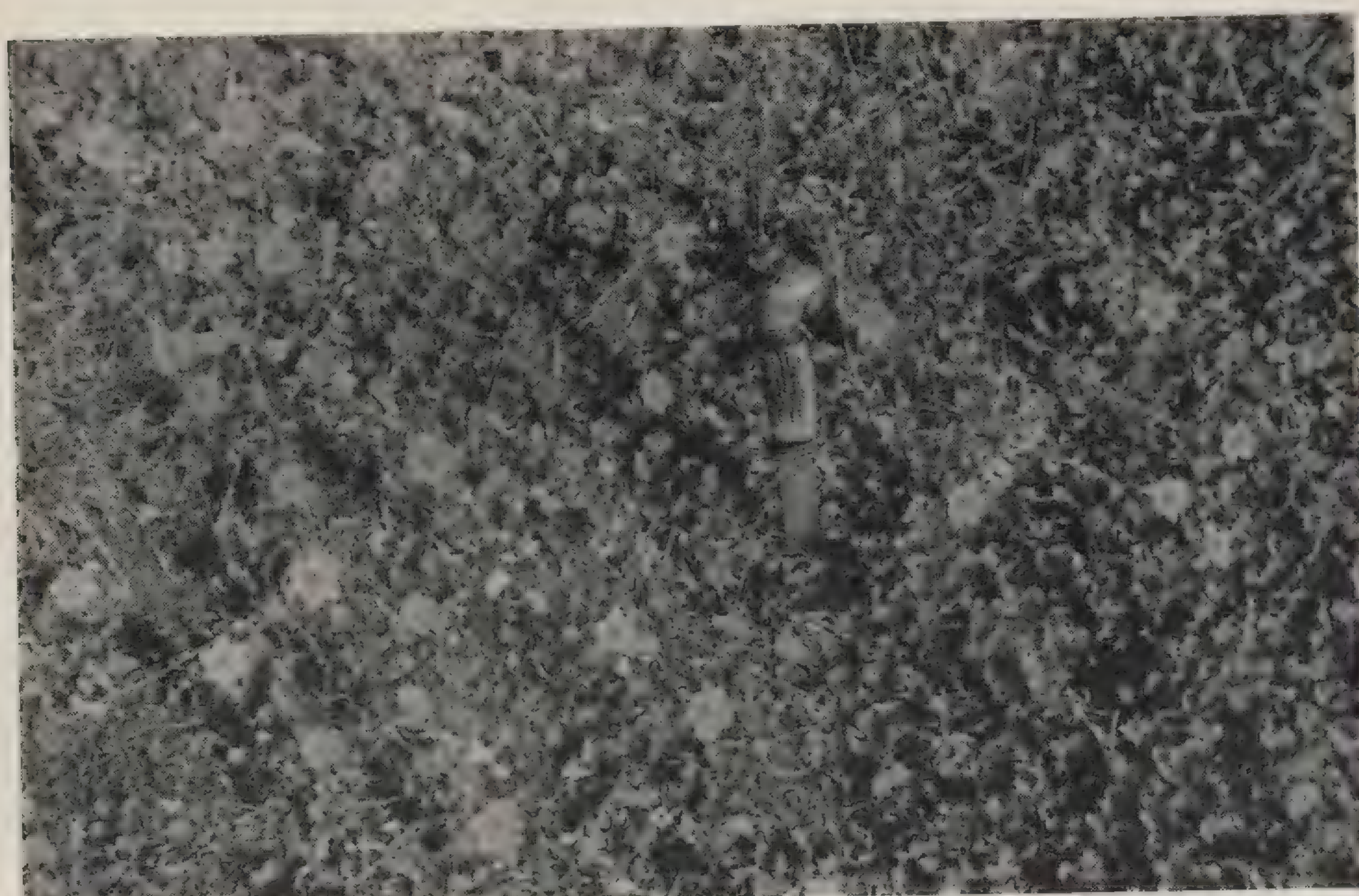
The tops of some of the higher tussocks are eroded and show stages of retrogression right to crustaceous lichens, whereas other dry areas have progressed to a heath stage, complete with Cladoniae and *Stereocaulon* spp. The soil is in most places dark and humous and, however dry it may be at the surface, is generally "squishy" wet beneath. Fungi occurring in these marshes included *Calvatia cretacea* and, in one place, *Melampsora vernalis* on *Saxifraga cernua*—also the usual *Ustilago inflorescentiae* on *Polygonum viviparum.* It was noted that under intense insolation here, as in Lapland and Labrador and doubtless most other southern lands, close tussocks of red Sphagna were much warmer to the touch than others of green or yellowish hue.

Plate LXXXIV, with *Rubus chamaemorus* in flower on a mossy patch of marsh, illustrates how extremely variable such areas may be, even here where vegetation has in general managed to "take a hold" of the surface; for within a few inches of one another we have on the left the usual sedgy-grassy dominants holding their own, and on the right the thin, cryptogamous sward is penetrated by jagged, uncolonized rocks.

PLATE LXXXIV

Rubus chamaemorus flowering on mossy patch in marsh. On the left the usual sedgy-grassy dominants are seen; on the right, uncolonized rocks project through the shallow mat. Wakeham Bay, N. Quebec, July 30, 1936.

PLATE LXXXV



Damp run-off area of latish snow "gulch" where dominated by *Anemone richardsoni* (in flower). Some small white flowers of *Draba fladnizensis* are seen to the left of the knife blade, and on the right are tall, fruiting axes of *Ranunculus nivalis*. Wakeham Bay, N. Quebec, July 30, 1936.

(iv) SNOW EFFECT

The zoned series of subclimaxes developed in areas occupied by late-melting snow patches will be described below from Wolstenholme, where they are similar but more frequently encountered and more extensive. However, small and luxuriantly vegetated late-snow "gulches" of the type described and illustrated above from Sugluk, and similarly developed around Wakeham Bay, were not encountered at Wolstenholme. Their lower levels, where the snow lasted well into the growing-season, were frequently characterized by such attractive small herbs as *Draba crassifolia* and *Parnassia kotzebuei* (the former unknown and the latter rare at Wolstenholme), or, in the lastingly damp run-off, by *Cerastium cerastoides*, *Draba fladnizensis*, and the coarser *Ranunculus nivalis* and *Anemone richardsoni*. Plate LXXXV shows such an area, dominated by the *Anemone* that is still in flower, with some tall fruiting axes of the *Ranunculus* on the right.

(v) SPECIAL LOCALIZED COMMUNITIES

The only type of terrain or vegetation belonging to this category that is worthy of mention from Wakeham Bay is the "flower slope" developed under a certain combination of favourable factors of shelter, aspect, substratum, snow-covering though early melt, etc. Apart from the slightly increased luxuriance and the presence of a few extra species, they were so like the slopes of this type developed at Wolstenholme that it will suffice to refer the reader to the description of the flower slopes of that place given later (*See* pp. 232-3).

(vi) FRESHWATER

Freshwater habitats were again numerous and variable, though few could be investigated in the unfortunately short time I had during my only visit to this place. It was noted, however, that the bouldery beds of shallow streams tended to be well clothed with such mosses as *Philonotis fontana* and *Drepanocladus* spp., and also supported numerous Algae of various affinities, including in one instance at least two species of *Microspora* (*M. stagnorum* and *M. willeana*). In sluggish eddies there were sometimes to be found *Ranunculus trichophyllus* var. *eradicatus* and *R. hyperboreus*, although both of these were more characteristic of standing water.

From two phials of the brownish deposit developed below where water seeps from the late-melting snow patches, the following Algae (excluding Diatomeae) were identified by Dr. Whelden (cf. Part II):

Aphanothece saxicola
A. stagnina
Chroococcus turgidus
Cosmarium anceps
C. biretum
**C. cyclicum* var. *nordstedtianum*
**C. debaryi*
C. granatum
**C. holmiense* var. *integrum*
C. ralfsii
**C. speciosum*
C. subcrenatum
C. undulatum
Euastrum dubium
E. rostratum
Gloeocapsa kuetzingiana
Gloeocystis gigas
Merismopedia glauca

* For explanation see next page.

Oncobyrsa cesatiana
Oocystis elliptica
Oscillatoria limosa
**Sphaerella nivalis*
Staurastrum dilatatum
S. inflexum
S. muticum
S. pachyrhynchum
S. proboscidium
S. punctulatum
S. varians var. *badense*
Tolypothrix limbata

The samples, preserved as usual in a mixture of alcohol, water, and glycerine, were taken on July 29 and 30, 1936, from below different snow patches, species marked '*' being present in both.

The aquatic and marginal communities of a large lake were very variable, as was the mineral shore or mossy bank forming its margin. In places there were boulders with only a scum of Algae or even no appreciable clothing at all; in others, fine beds of dark brown aquatic mosses, or *Ranunculus trichophyllus* var. *eradicatus* with its glistening white axes, could be seen extending out to a considerable depth. Where the bottom was of mud it was apt to be colonized to a depth of at least 40 cm. by large, coarse plants of *Eriophorum angustifolium* or *Carex aquatilis* var. *stans*. The slimy scum on the axes of these colonists was made up of the following diverse and interesting Algae (excluding Diatomeae):

Bulbochaete intermedia
Calothrix fusca
Chroococcus turgidus
Closterium parvulum
†*Cosmarium botrytis*
C. conspersum
C. costatum
C. granatum
C. quadratum
C. ralfsii
†*C. subcrenatum*
C. subundulatum
†*Dinobryon sertularia*
D. tabellariae
†*Draparnaldia glomerata*
Euastrum bidentatum
E. binale var. *sectum*
†*E. elegans*
Gloeocapsa rupestris
Gloeothece rupestris var. *maxima*
†*Hyalotheca dissiliens*
Palmodictyon varium
Peridinium cinctum
Schizothrix lardacea
Sphaerozosma granulatum
Staurastrum brevispinum
S. clepsydra
†*S. cyrtocerum*
S. furcigerum
S. muticum
S. orbiculare var. *ralfsii*
Tolypothrix limbata
†*T. tenuis*
Zygnema cyanospermum

† For explanation see next page.

Deposits on mud at the edge of the water included the species marked '†' in the above list, and, in addition, and in spite again of the exclusion of any Diatomeae, all of the following:

ALGAE	*Aphanocapsa pulchra*[1]
	Aphanochaete repens
	Aphanothece stagnina
	Arthrodesmus ralfsii
	Bulbochaete repanda
	Closterium abruptum
	Cosmarium arctoum
	C. bioculatum
	C. crenatum
	C. cucumis
	C. ochthodes
	C. phaseolus
	C. ralfsii var. *montanum*
	C. regnesi
	C. reinschii
	C. sexangulare
	C. subhieronymusii
	C. undulatum
	Euastrum binale
	E. dubium
	E. montanum
	Glenodinium dybowskii
	Microcystis flos-aquae
	Microspora stagnorum
	Oocystis elliptica
	Scytonema ocellatum
	Spirogyra inflata var. *foveolata*
	Staurastrum aculeatum
	S. alternans
	S. apiculatum
	S. cristatum
	S. furcatum
	S. glabrum
	S. inconspicuum
	S. iotanum
	S. mucronatum
	S. polymorphum
	S. punctulatum
	S. setigerum
	S. subpygmaeum var. *subangulatum*
	S. vestitum
	Stigonema informe
	Zygnema sp.
FUNGI	*Olpidium utriculiforme*[2] parasitic in *Euastrum bidentatum*
	Phlyctochytrium magnum parasitic on *Zygnema* sp.

These three long lists of Algae have been compiled from only six samples taken within a mile of one another at Wakeham Bay; they exclude the diatoms, which have not been determined from this place. Few of the numerous species were identified in more than two samples, which altogether suggests that the algal flora of the region is probably very considerable.

The lake marginal communities on land are also very variable. In some places heaths extend almost to the water's edge, being fringed merely by a narrow band of Sphagna or lower mosses; in others there is a marsh that is typically continued into the water by a bed of *Eriophorum angustifolium* or

[1] This species and in addition *Staurastrum lunatum* var. *planctonicum* occurred in the one sample taken in such a situation at Sugluk.

[2] The record of this species from Wakeham Bay is unfortunately omitted from Part II of the present series, p. 242.

Carex aquatilis var. *stans*. Elsewhere, again, there is only damp mud colonized by *Eriophorum scheuchzeri, Phippsia (Catabrosa) algida* (rarely seen elsewhere at Wakeham Bay), or long trailers of *Carex chordorrhiza*.

(vii) SEASHORE

The shingle above high tide-mark is colonized by the usual *Arenaria peploides* (mostly var. *diffusa*), *Mertensia maritima* var. *tenella*, and *Elymus arenarius* var. *villosus* (apprg. var. *villosissimus*)[1], of which the last-named forms luxuriant tall beds (*See* Plate LXXXVI). Various plants are associated, including *Carex maritima, Cochlearia officinalis* var. *oblongifolia, Festuca rubra* var. *arenaria, Matricaria inodora* var. *nana, Poa glauca,* and *Puccinellia angus-*

PLATE LXXXVI

Shingly beach bound by swarded *Elymus*, etc. Farther down, between tide-marks, the shore is darkened by algal growth. Floating on the water of the bay, around the Canadian Government and Hudson's Bay Company's icebreaker R.M.S. *Nascopie*, are numerous ice-pans. Wakeham Bay, N. Quebec, July 30, 1936.

tata—as well as many others from the vegetated land areas behind (such as that listed on pp. 212-3) or, in damp saline depressions, a whole "saltmarsh" contingent dominated by *Puccinellia phryganodes* or phases of *Carex salina*, and including *Carex bipartita* var. *amphigena, Cochlearia officinalis* var. *groenlandica*, various phases of *Dupontia fisheri, Koenigia islandica, Montia lamprosperma, Puccinellia paupercula, Stellaria crassifolia, S. humifusa*, and the familiar Alga *Ulothrix flacca*.[2] Other plants common on the shore, mostly in dry places, included *Campanula rotundifolia* s.l., *Papaver radicatum, Potentilla nivea* var. *subquinata*, and *Taraxacum lacerum*.

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[1] No parasitization of this "Lyme grass" was noted at Wakeham Bay, but at Sugluk the *Elymus* was attacked by *Lophodermina culmigena* and *Cladosporium bruhnei*.

[2] At both Sugluk and Wolstenholme (q.v.), the characteristic plants of this community were much the same except that they included *Carex ursina* and *Chrysanthemum arcticum*, which have not yet been found at Wakeham Bay. At Sugluk, too, were noted in such situations both *Potentilla egedii* and *Deschampsia caespitosa* var. *littoralis* (agg.), neither of which is known from Wakeham Bay or Wolstenholme.

Between tide-marks[1] the boulder-strewn shore is dark with Algae, chiefly *Fucus vesiculosus*, whose growth is fairly luxuriant except toward the uppermost limits, and, in pools, much *Pylaiella littoralis* and *Ulothrix flacca*, with sometimes a little *Petrocelis cruenta*. The darkening by Algae is very noticeable in Plate LXXXVI, although, actually, growth of macroscopic forms is limited to the sides of rocks and boulders or the sheltered depressions between them, as the tops and all projections are frequently ground by ice-pups of which great numbers may persist almost throughout the summer.

Whereas some may be assumed to occur in the vicinity, no large laminarians were seen growing at Wakeham Bay and few of any size were found loose upon the beach, where, during my visit in July, 1936, at least 90 per cent. of the cast-up algal material consisted of *Fucus vesiculosus*.

Plant Communities Around Wolstenholme

Cape Wolstenholme, most northerly point of the mainland of Quebec, is situated in latitude 62° 35′ N., longitude 77° 30′ W. The Hudson's Bay Company's trading post, established in 1909, is situated some miles to the southeast, in Eric Cove. The following observations on the vegetation were made both at the Cape and around and inland of the post, though all within a radius of a few miles of the latter and thus in a small district that may most conveniently be known by the general name of Wolstenholme.

The country here is bold and rugged, the physiographic changes being drastic in the extreme. At Cape Wolstenholme itself the cliffs are perpendicular and rightly deserving of the designation "stupendous", for they rise sheer out of the water to a height that has been reported to approach 2,000 feet[2] (Havergal 1915, p. 244, and cf. Plate XCIII below). Southward at a considerable altitude extends a somewhat broken plateau, although just inland of the post there is a broad valley that winds southward for several miles (cf. Plate LXXXVII). The uplands are rocky and barren (cf. Plate LXXXVIII), and the lowlands in most places far from luxuriant. The climate is cool, apparently foggy, and certainly very "late", there being frequently an abundance of snow-patches lasting far into the summer even near sea-level, and in many instances on north-facing slopes disappearing only after a cycle of exceptionally warm or dry years. These persistent patches are due to the combination of such circumstances as plentiful winter snowfall and a cool and cloudy summer.

The fundamental rocks are gneisses, some bands being highly ferruginous and imparting a reddish brown aspect to weathered surfaces and to any resulting "soil". The lowlands and side valleys up to nearly 700 feet (213 m.) show a fine series of marine terraces. These consist of rewashed glacial material that in places contains a fair amount of limestone—especially at the lower altitudes, where an abundance of marine shells adds considerably to the $CaCO_3$ content of the veneer.

(i) UPLANDS

As far as these were explored, it was seen that with gradual reduction in luxuriance and in the number of associates, the "blueberry heath" and some other relatively advanced communities of the lowlands extended, at least where there was soil and shelter, up to an altitude of about 800 feet (cf. Plate

[1] According to Smith (1932, p. 4), the tidal range (average perigean springs) at Wakeham Bay is 30 feet, mean neaps being 9½ feet.

[2] *See* footnote ([1]) on page 201, and cf. page 234.

LXXXVIII). Thereafter, such lowland communities became more and more restricted to occasional small areas that offered unusually favourable conditions of shelter and aspect, and, except for small late-snow areas of *Cassiope* or *Salix herbacea* "heath", none was seen much above 1,000 feet (305 m.).

PLATE LXXXVII

Well-vegetated upland slope ("blueberry heath" with grasses, etc.) overlooking broad valley with winding stream. Farther back, from behind author's head and up to the right-hand corner, the same slope is practically barren. Wolstenholme, N. Quebec, Aug. 1, 1936.

In general at this level, and almost everywhere above, both plateau and hills were found to be rocky and barren, even around lakes. Plate LXXXVIII shows such a typical area of crags and slopes both steep and gentle, but essentially rock-bound and devoid alike of soil and higher vegetation. Such country is monotonous and difficult to travel in—especially during summer, the only time when it is possible to make general investigations of the vegetation. To be sure, the rocks abound in crustaceous and other lichens, and the occasional patches of more finely comminuted "soil" here and there support a few vascular plants[1]; but almost all species are of poor growth, such areas constituting a true desert in more senses than one. There is, however, one "higher" community that frequently occurs, and may sometimes carpet areas many square metres in extent even where the surface is entirely of boulders. This is a luxuriant mat composed almost entirely of the semi-ubiquitous moss *Rhacomitrium lanuginosum*, and supporting a fair abundance of, most typically, *Luzula confusa* and *Hierochloe alpina*. Frequently these last render the community straw coloured, so that it affords a welcome relief to the dark grey of the usual gneiss, which on the plateau less frequently retains that warmer, ferruginous brown on weathering.

[1] These are mostly rather high-arctic species, the ones most frequently encountered being *Cassiope tetragona*, *Phippsia (Catabrosa) algida*, *Eriophorum scheuchzeri*, *Hierochloe alpina*, *Luzula confusa*, *Pleuropogon sabinii*, *Poa arctica*, *Ranunculus hyperboreus*, *Salix arctica*, and *S. herbacea*.

Typical desert area with small, rock-bound lake. Bedrock and boulders are of grey gneiss, in most places supporting only crustaceous lichens of poor growth. There is no true soil. Wolstenholme, N. Quebec, Aug. 24, 1936.

(ii) LOWLANDS

Perhaps most typical of all the variable lowland series of communities, only the outstanding members of which need be described, is the mixed heath developed on sandy and gravelly areas—especially on the "raised beaches" and terraces. This heath, of course, varies in luxuriance and composition according to the situation, being especially dwarfed and lichenous on raised areas that have little snow-covering in winter, and little shelter at any season. On the other hand, in sheltered depressions it is comparable in luxuriance with the rather similar heath developed in such situations at Wakeham Bay. An important difference is, however, the complete lack of tall bushy willows around Wolstenholme.

The following was the phanerogamic constitution of the rather luxuriant heathy community developed on a sheltered gravelly slope, as exemplified by a 5-metre quadrat:

Vaccinium uliginosum var. *alpinum*	vad
Salix arctica (incl. var. *kophophylla*)	a
Carex bigelowii	f-la
Cassiope tetragona	f-la
Hierochloe alpina	f
Poa arctica	f
Polygonum viviparum	f
Vaccinium vitis-idaea var. *minor*	f
Stellaria longipes	r-f
Arctostaphylos alpina	o
Carex scirpoidea	o
Epilobium latifolium	o

Luzula spicata	o
Pedicularis lapponica	o
Potentilla hyparctica var. *elatior* (*P. emarginata*)	o
Saxifraga tricuspidata	o
Antennaria angustata	r
Arnica alpina agg.	r
Campanula uniflora	r
Oxyria digyna	r
Salix cordifolia var. *macounii*	r
Taraxacum lacerum	r
Trisetum spicatum var. *maidenii*	r
Cerastium alpinum	vr
Oxytropis maydelliana	vr
Saxifraga cernua	vr
Silene acaulis var. *exscapa*	vr
Antennaria canescens	(1)
Draba nivalis	(1)

Mosses, such as *Kiaeria starkei* and *Pleurozium schreberi*, consolidated the sward, and lichens were also abundant and of fair growth—especially Cladoniae and *Pertusaria dactylina*. The soil was dark and humous but only very slightly acid (pH 6·6). It appeared to remain damp throughout the summer. Several parasitic and other Fungi occurred, including *Calvatia cretacea*, *Exobasidium vaccinii-uliginosi* on *Vaccinium vitis-idaea* var. *minor*, *Omphalia umbellifera*, and *Puccinia bistortae* on *Polygonum viviparum*.

Although not occurring in the quadrat listed, *Empetrum nigrum* var. *hermaphroditum* and *Ledum palustre* var. *decumbens* were plentiful or even locally dominant in surrounding areas, where *Phyllodoce coerulea* was sometimes to be found. However, in the more exposed or otherwise less favourable places where there was some fine "soil" material these additional ground-shrubs were generally absent, the result being a relatively poor or even improperly closed, cryptogamous "blueberry heath." This covered considerable areas on the dry valley sides, two 4-metre quadrats taken from different examples at altitudes of not more than 400 feet (122 m.) about 5 miles inland, beyond the end of the main valley, yielding the following composite list of phanerogams:

Vaccinium uliginosum var. *alpinum*	a-vad
Arctostaphylos alpina	o-acod
Carex bigelowii	a
Vaccinium vitis-idaea var. *minor*	a
Salix herbacea	f-la
Hierochloe alpina	o-la
Luzula confusa	f
Polygonum viviparum	o-f
Salix arctica	o
Dryas integrifolia	absent-o
Pedicularis lanata	absent-o
Poa arctica	r
Antennaria labradorica	absent-r
Carex nardina	absent-r
Cassiope tetragona	absent-r
Pedicularis hirsuta	absent-r
Pyrola grandiflora (vegetative only)	vr
Kobresia myosuroides (*K. bellardi*)	(1 tuft)
Oxytropis maydelliana	(1)

The areas looked yellowish or straw coloured from a distance, due to the projecting leaves and axes of grasses and the *Luzula and Carex bigelowii*, or, in some places, to light-coloured lichens such as *Stereocaulon alpinum*, *Cetraria cucullata*, and *C. nivalis*. These were, indeed, among the most plentiful species, although a great number of other lichens occurred—and also some mosses, of

which the most typical and constant were *Polytrichum hyperboreum* and *Rhacomitrium lanuginosum*. Nevertheless, the community frequently lacked proper consolidation, being interrupted by patches of bare gravel, frost-shattered detritus, or even finely comminuted "soil." There was no peat accumulation and, except as a lining to litter-filled depressions, very little humous deposition to stain the gritty and shallow subsoil—which was, however, distinctly acid (pH 5·8 in the one example tested). Rather numerous parasitic Fungi were evident in this community in late August both in 1934 and 1936, the *Salix herbacea*, particularly, appearing to be weakened by its unfavourable habitat, and accordingly subject to grievous harm from the (frequently combined) attacks of two of these parasites. The chief ones noted, admittedly over much more considerable areas than those listed above, were:

Cintractia caricis[1] on *Carex bigelowii*
Exobasidium angustisporum on *Arctostaphylos alpina*
E. vaccinii var. *myrtilli* on *Cassiope tetragona*
E. vaccinii-uliginosi on *Vaccinium uliginosum* var. *alpinum*[1] and *V. vitis-idaea* var. *minor*
Mycosphaerella salicicola on *Salix herbacea*
Puccinia bistortae on *Polygonum viviparum*
Rhytisma salicinum[1] on *Salix herbacea*
Uromyces lapponicus[1] on *Oxytropis maydelliana*
Venturia chlorospora on *Salix herbacea*

Elsewhere the valley slopes may be of *Dryas* or other "barrens," or even devoid of higher plants—especially where they are of cliffs, broken crags, or dynamic screes. However, even here a few chomophytic ferns (especially *Cystopteris fragilis* but sometimes also *Woodsia glabella*) and other vascular plants are usually to be found.

The valley flats and terraces of sandy gravel or morainic boulders are also in many places only very poorly vegetated, although more often carrying a fair plant covering. The communities are extremely variable, although the flora is very limited in most places; in fact the most remarkable feature from the ecologist's point of view is the tendency to pure dominance by one plant or another over small tracts, possibly owing to occasional disturbance by flooding or other agencies. One highly characteristic community developed on sandy riverside or coastal flats and slopes has *Luzula confusa* as the only higher plant present, and *Polytrichum hyperboreum*, efficiently binding the surface between the *Luzula* tussocks, as the only lower one.

Another type is seen in Plate LXXXIX, where coarsely growing *Carex bigelowii* is colonizing and stabilizing the surface unaided by any other plants. Yet another type is characterized by a dense "silvery" mat of *Rhacomitrium lanuginosum* from which protrude occasional to locally abundant axes of *Hierochloe alpina*, but often nothing else. Where the surface is more gravelly and less liable to movement or erosion, spreading or rhizomatous ground-shrubs take a hand in its colonization and stabilization—particularly *Arctostaphylos alpina*, *Empetrum nigrum* var. *hermaphroditum*, *Salix herbacea* or *S. uva-ursi*, *Vaccinium uliginosum* var. *alpinum*, or, very occasionally, *Loiseleuria procumbens* or matted Antennarias.

The sides and lower angles of occasional sheltered bays or sheltered gulches, where the snow drifts deeply in winter but drainage and aeration are good, although a modicum of moisture is retained by the turfy upper layers, are vegetated by an interesting sward of grasses and sedges. These include *Carex canescens*, which in the whole of our area has been found only in this habitat at

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[1] According to my field notes only, and not reported in Part II.

PLATE LXXXIX

Carex bigelowii in anthesis, stabilizing sands of riverside flats unaided by any other plants. Wolstenholme, N. Quebec, Aug. 1, 1936.

Wolstenholme (*See* Part I, p. 117), and *Calamagrostis canadensis* var. *scabra*, which attained upwards of a metre in height and so exceeded all other plants in the neighbourhood. One such bank supported the following vascular plants, of which the *Calamagrostis* and *Carex bigelowii* were each "lvad", and *Salix herbacea* occupied that part of the bottom of the gulch where the snow and seepage lasted longest each summer:

Agrostis borealis
Arenaria sajanensis
Calamagrostis canadensis var. *scabra*
Carex bigelowii
C. bipartita
C. canescens
C. norvegica (C. halleri)
Juncus trifidus
Poa glauca
Salix herbacea
Trisetum spicatum

(iii) MARSHES

With the general lack of soil in the uplands and the easily drained nature of the substratum in the lowlands, the marshy areas encountered were all of rather small extent and poor development, being otherwise comparable with the less luxuriant types at Wakeham Bay (*See* above). However, *Rubus chamaemorus* appeared to be absent at Wolstenholme and the expected *Salix arctophila* and *Eriophorum spissum* were not seen, although *E. callitrix* occurred. The usual dominants, which were frequently mixed, were *Arctagrostis latifolia, Carex aquatilis* var. *stans, C. rariflora, Dupontia fisheri, Eriophorum angustifolium,* and *E. scheuchzeri.* The dominance was, however, generally poor, leaving room for rather numerous associates, which most typically comprised other species

of *Carex, Cardamine pratensis* var. *angustifolia* (leaves only), Equiseta, Junci, Saxifragae, and the like—or, rather rarely, *Calamagrostis neglecta* var. *borealis, Epilobium davuricum* var. *arcticum,* and *Luzula spadicea.* The moss-consolidation of these marshy areas was also rather poor, especially inland in the apparent absence of pasturage by wildfowl, and no extensive humous accumulation was noted.

(iv) SNOW EFFECT

With the similar abundance and extent of persistent snow-patches even near sea-level, "late-snow" zoned subclimaxes as at Cape Dorset are areally quite important. They are also rather similar in sequence and composition at these two places situated not so far apart on opposite shores of Hudson Strait, the following being a typical series at Wolstenholme:

Zone I. Just outside the usual *Cassiope* zone there is generally an area (or at least a narrow belt) in which the benefit of extra shelter and snow-covering is obvious, whether the surrounding community be one of the heathy types listed above or some other sort altogether. Thus in Plate XCI the rocks of the ongoing slope at the extreme top are devoid of higher vegetation, but below, in the middle distance where there is some shelter and snow-covering, a lichenous, grassy-heathy community develops before the foreground of *Cassiope* heath is reached. This last almost invariably constitutes the next zone.

PLATE XC

Arnica alpina (agg.) flowering among grasses (especially *Hierochloe alpina*) and Carices on dry, lichen-rich area above 'flower slope'. Wostenholme, N. Quebec, Aug. 27, 1934.

Zone II. Cassiope tetragona is overwhelmingly dominant and generally of good growth. Most often it forms a continuous mat, but even if tussocky and interrupted it darkens the area as a whole, in the manner frequently noted elsewhere (*See* above). Although toward the inside of this zone the growing-season is so shortened by the late melting of the snow that the more exacting *Empetrum* and other ground-shrubs are largely ousted, several may occur farther out in it—especially toward its outside, or in the ecotonal margin where *Vaccinium uligino-*

sum var. *alpinum* may even be dominant. A typical area toward the centre of the frequently broad *Cassiope* zone had the following composition as regards vascular plants:

Cassiope tetragona[1]	vad
Carex bigelowii	a
Hierochloe alpina	a
Luzula confusa	f-a
Salix herbacea	o-la
Vaccinium uliginosum var. *alpinum*	r-la
V. vitis-idaea var. *minor*	lf
Carex misandra	o
Luzula nivalis	o
Polygonum viviparum	o
Pedicularis lapponica	r
Lycopodium selago	r
Pedicularis hirsuta	vr

PLATE XCI

Luxuriant *Cassiope* heath of latish snow zone, interrupted by projecting boulders supporting only cryptogams. In the background is a lichenous, mixed grassy heath and behind that are almost barren rocky slopes. Wolstenholme, N. Quebec, Aug. 27, 1934.

[1] Frequently attacked by *Exobasidium vaccinii* var. *myrtilli*.

The *Cassiope* grew 8 to 10 cm. high and covered practically the whole area, except where it was interrupted by projecting boulders that supported only lowly cryptogams. The chief mosses in the *Cassiope* sward were *Rhacomitrium lanuginosum* and *Kiaeria starkei*, and the fairly plentiful lichens included Cladoniae, *Ochrolechia frigida*, *Pertusaria dactylina*, and *Stereocaulon alpinum*. Occasional small "open" patches of these and other cryptogams interrupted the heath, a fair "reindeer-moss" sward being sometimes developed over very limited areas. The rather meagre soil had a thin covering of dark humus and was distinctly acid in reaction (pH 5·6).

PLATE XCII

Rocky hillside with ledges occupied by luxuriant light-coloured mats of *Rhacomitrium lanuginosum* (*See* pages 188-9). Snow drifts deeply in the foreground, which is vegetated chiefly by *Salix herbacea* and cryptogams. Port Burwell, N. Labrador, Sept. 24, 1934.

Zone III. This, at least in its centre, is diminutive and largely composed of *Salix herbacea*. In its soft green carpet are generally associated some *Polygonum viviparum*, *Luzula confusa*, and *Pedicularis lapponica*—also, less typically,

Hierochloe alpina and *Silene acaulis* var. *exscapa*. The mosses include *Polytrichum strictum*, and such lichens as *Cetraria islandica, Solorina crocea, Stereocaulon alpinum*, and *S. denudatum* may also occur. Although the surface of the soil is almost invariably dark with humus, this typically forms only a thin crust, the material beneath being almost exclusively mineral. Insect galls and parasitic Fungi are not infrequent on the *Salix herbacea*, and a few small saprophytic Fungi may also grow on the humus—especially the common *Calvatia cretacea* and *Omphalia umbellifera*.

Zone IV. Inside, where the snow melts much too late for most woody plants to grow, and even for *Salix herbacea* to be more than frequent, an herbaceous "half-barren" is developed as at Dorset (*See* p. 171). Just here, many species are to be seen still flowering in late summer, the most characteristic colonists being *Arenaria sajanensis, Cerastium alpinum, Erigeron unalaschkensis, Luzula confusa, Oxyria digyna, Pedicularis hirsuta, Poa arctica, Potentilla hyparctica* f. *tardinix (P. emarginata* f. *tardinix), Ranunculus nivalis* and *R. pygmaeus, Salix herbacea, Trisetum spicatum* var. *maidenii*, and various Saxifragae. Few lichens persist so far in, although there are generally some small squamules of *Cetraria crispa*, and characteristic, silt-binding knobs of *Solorina crocea*. Mosses are here more in evidence, including *Ceratodon purpureus* and *Pogonatum urnigerum*, and the peculiar liverworts *Gymnomitrium corallioides* and *G. concinnatum* may form a close bluish grey investment.

Zones V, etc. The central "barren", moss-mat, etc., regions are often confused, and indeed so rarely delimited that it would be scientifically improper to try to distinguish them in this generalized account. Characteristic species include the same two diminutive liverworts,[1] *Rhacomitrium sudeticum* among the mosses, and *Phippsia (Catabrosa) algida, Saxifraga rivularis*, and sometimes *S. cernua* or dwarfed *Luzula confusa* among the angiosperms.

(v) SPECIAL LOCALIZED HABITATS AND COMMUNITIES

Of these, two main types were encountered. The first is the "flower slopes", which, as has already been mentioned above (p. 219), are developed here as at Wakeham Bay under a peculiar combination of favourable factors of shelter, aspect, substratum, good snow-covering but early melt, etc. The main difference of the Wolstenholme flower slopes from those developed at Wakeham Bay (and, incidentally, at Sugluk) are that the Wolstenholme ones are less luxuriant, and lack certain rank species that are found chiefly to the south and east. Nevertheless, the community is loosely closed and the flora large and variable, as the following list from one small area will indicate—especially when it is mentioned that almost all the species were to be seen quite clearly from one sitting position. The frequency degrees are only rough and relative, being in most instances computed from the said sitting position when I was injured:

Astragalus alpinus	va
Salix arctica	lva
Hierochloe alpina	a
Poa arctica	a
Polygonum viviparum	a
Campanula uniflora	f
Euphrasia arctica var. *minutissima*	f
Carex bigelowii	f
Pedicularis lapponica	f
Salix herbacea	f

[1] Other liverworts collected in one area were *Aplozia pumila, Marsupella groenlandica*, and *Scapania undulata*.

Vaccinium uliginosum var. *alpinum*	f	
Arnica alpina agg.	o	
Kobresia myosuroides (K. bellardi)	o	
Luzula spicata	o	
Oxytropis maydelliana	o	
Potentilla hyparctica var. *elatior* *(P. emarginata)*	o	
Stellaria longipes	o	
Antennaria tansleyi	r	
Carex norvegica (C. halleri)	r	
Cerastium alpinum	r	
Draba glabella var. *brachycarpa*	r	
D. nivalis	r	
Epilobium angustifolium (leaves only)	r	
Erigeron eriocephalus	r	
Festuca brachyphylla	r	
Pedicularis flammea	r	
Poa pratensis s.l.	r	
Pyrola grandiflora	r	
Salix cordifolia var. *callicarpaea*	r	(up to 25 cm.)
Taraxacum lacerum	r	
Carex capillaris	vr	
Eutrema edwardsii	vr	
Poa glauca	vr	
Salix reticulata	vr	
S. uva-ursi	vr	
Silene acaulis var. *exscapa*	vr	
Trisetum spicatum var. *maidenii*	vr	

In spite of the length of this list, the community is far less luxuriant than the flower slopes described above from Lake Harbour (*See* pp. 151-3). Cryptogams may form a meagre layer over the coarse, mineral substratum. Plate XC (on page 229) shows *Arnica alpina* (agg.) in flower, with much *Hierochloe* and other grasses and Carices, and with an unusual abundance of consolidating cryptogams (especially lichens), on the slope above the area listed, where the surface is drier and more exposed, and the community much more grassy.

The other special localized community (or rather, series of communities) is that developed around the tops of the great cliffs forming Cape Wolstenholme. On the innumerable rock ledges of these cliffs, countless sea-birds nest each year in such close formation and with the production of so much manure and ultimately guano that few plants of any sort can attain ecesis. However, where nests extend to near the tops of the cliffs, it can be seen that any adjacent unoccupied ledges and crannies are vegetated by luxuriant coarse grasses and Cochleariae, and that the rock faces are largely covered by lichens, often of extraordinary size.

No less remarkable are the changes wrought on the cliff-tops. Here, owing to the activity of scavengers and probably also to the foul vapours rising from the nesting sites, there are developed the luxuriant nitrophilous "patchwork quilt" and other communities of the type that I described some years ago from Akpatok Island (1935, pp. 174-8). To this detailed account I would refer the reader; the Wolstenholme communities merely differed in association and minor detail, possibly in some degree owing to the acidic substratum afforded by the gneiss.

Bearing in mind the desert barrenness not far away of the typical area of plateau that was seen in Plate LXXXVIII, we may rightly be amazed to compare Plates XCIII, XCIV, and XCV of cliff-top areas, which, being more exposed,

would doubtless be still more "sterile"—were it not for the birds. These cliff-tops are covered with a continuous dense sward of thickly matted "peat" and vegetation, which brings home most forcibly the fact that a general deficiency in food-salts is one of the chief factors inhibiting plant growth over most areas of arctic terrain.

PLATE XCIII

Dark bird-cliffs at Cape Wolstenholme enveloped in fog below. On top, in the foreground, is a dense sward of coarse grasses with which may be contrasted the barren hinterland shown in Plate LXXXVIII. Wolstenholme, N. Quebec, Aug. 24, 1936.

The chief bird nesting on the cliffs appeared to be Brünnich's guillemot (*Uria lomvia* L.), whose screaming set up an almost continuous roar, and the chief scavengers were probably glaucous gulls (*Larus hyperboreus* Gunn.). The height of the cliffs, which during my only visit to their tops I unfortunately had no aneroid to measure, is supposed to be nearly 2,000 feet (610 m).[1] Nor was I able to see the sea below, owing to a low-lying cloud, although I myself stood much of the time in brilliant sunshine. Plate XCIII shows the dark cliff face that is inhabited in summer by such great numbers of birds; it drops sheer into the mist and ultimately into the sea. In the foreground is the cliff top, vegetated by a luxuriant sward of coarsely grown grasses just where the biotic factor is most intense. Behind stretches the smoother "patchwork quilt" of mixed and multicoloured lichens and mosses (*See* Plate XCIV) that frequently extends 100 m. or more inland. That lichens in goodly rosettes, frequently as much as 20 cm. in diameter, tend to form the more lightly coloured elements of this patchwork is seen in Plate XCV of a small but characteristic area. Even on rock faces and projecting boulders, the crustaceous and other lichens were of almost unparalleled luxuriance—including individual fronds of Gyrophorae up to 10 cm. in diameter—and suggested a relatively rapid progression of the xerosere right from its early stages.

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[1] The height marked on the latest (1943) maps is, however, only 1,260 feet.

Plate XCIV

Smooth "patchwork quilt" of mixed and many-coloured lichens and mosses developed near top of bird-cliff. The vegetation forms a continuous sward, underlain by a considerable depth of humus. Wolstenholme, N. Quebec, Aug. 24, 1936.

Plate XCV

Small area of "patchwork quilt" (scale given by pipe) showing luxuriant rosettes of whitish *Thamnolia vermicularis* and other lichens on the dark, mossy background. A few associated grassy herbs are to be seen. Wolstenholme, N. Quebec, Aug. 24, 1936.

Of this peculiar vegetation above the bird-cliffs there are two main phases. The first is the dense, grassy sward developed near the edge of the cliffs and in damper depressions behind, the spermatophytes being in one typical example as follows:

Poa arctica	vad
Alopecurus alpinus	f-lva
Cerastium alpinum	f
Cochlearia officinalis vars.	o-f
Saxifraga rivularis	o
Stellaria longipes	o
Saxifraga cernua f. *latibracteata*	r
S. stellaris var. *comosa*	r
Salix arctica (sprigs only)	vr

Often there are no other phanerogams[1] to be found over many square metres, the whole being bound by a continuous investment of luxuriant mosses into which the feet may sink for 8 to 10 cm. Below is soft and "squishy"-wet, reddish brown humus. Lichens are few or even absent just here. The chief mosses in one area were as follows, the species being here less mixed than in the patchwork quilt:

Aulacomnium palustre
Brachythecium albicans
Calliergon cordifolium
C. sarmentosum
C. stramineum
Campylium stellatum
Drepanocladus uncinatus

In one place at the margin of a small pool, whose water was a "farmyard" brown and stinking, grew *Puccinellia phryganodes* and *Stellaria humifusa*, which I have elsewhere never seen away from the immediate seashore, and also *Deschampsia pumila* and *Eriophorum angustifolium*.

The other typical vegetation phase above the bird-cliffs is the "patchwork quilt", already mentioned above and figured in Plates XCIV and XCV. It covers most of the general surface and all drier, raised areas. Lichens, chiefly in luxuriant rosettes up to 22 cm. in diameter, occupy most of the surface, mosses forming rather the general foundation on which they grow, and closing the whole area. As with the lichens, the mosses are much mixed as regards species; on the other hand, except for *Poa arctica*, which is generally plentiful, vascular plants are few in both individuals and species. A 4-metre quadrat had the following composition:

SPERMATOPHYTA	*Poa arctica*	a"d"
	Cerastium alpinum	r-f
	Luzula confusa	r-f
	Alopecurus alpinus	o
	Stellaria longipes	r
MUSCI	*Aulacomnium palustre*	
	A. turgidum	
	Dicranum fuscescens	
	D. groenlandicum	
	D. scoparium[2]	
	Drepanocladus uncinatus	
	Polytrichum hyperboreum	
	P. juniperinum	
	P. yukonense	

[1] Much the same species occurred on ledges toward the tops of the cliffs, and, in addition, *Phippsia (Catabrosa) algida* and *Oxyria digyna*.

[2] The record of this species from Wolstenholme is unfortunately omitted from Part II, p. 397.

LICHENES *Cetraria cucullata*
C. islandica
C. nivalis
Cladonia coccifera var. *pleurota*
C. mitis
C. uncialis
Sphaerophorus fragilis
Thamnolia vermicularis

The cryptogams included in the above list were all of some ecological importance, the lichens being so much more constant than the mosses that few further species could be added by searching other areas, whereas the mosses appeared to change without rule or reason. The surface presented a flat or only gently undulating but pleasingly soft quilt, into which the feet sank for about 5 cm. Beneath came a considerable depth of damp, reddish brown, humous soil.

Besides the cryptogams listed above as being more or less characteristic components of these nitrophilous bird-cliff swards, the following were also collected on this "manured" cliff-top at Cape Wolstenholme. Most were taken from rock faces or projecting boulders, where they grew with such unusual luxuriance that even the crustaceous species could easily be cut away with a knife; many, however, have not been found elsewhere in the district:

MUSCI *Bryum arcticum*
Dicranum bonjeanii
Drepanocladus aduncus var. *polycarpus*
Hylocomium splendens
Pohlia nutans
Rhacomitrium lanuginosum
Timmia austriaca

LICHENES *Caloplaca elegans*
C. fraudans
Cladonia coccifera var. *stemmatina*
Gyrophora arctica
G. hyperborea[1]
G. vellea
Haematomma ventosum var. *lapponicum*
Lecanora atra
L. badia var. *cinerascens*
L. campestris?[2]
L. intricata
L. polytropa var. *leucococca*
Lecidea arctogena
L. atrobrunnea
L. tesselata
Ochrolechia frigida
Parmelia alpicola
P. physodes
Peltigera canina f. *membranacea*
Xanthoria candelaria

(vi) FRESHWATER

Freshwater habitats were only cursorily investigated at Wolstenholme, partly owing to their rather small area and poor development, and partly because of the unfortunate brevity of my three visits to this interesting place. Hence a a few notes must suffice, as is the case also with the saltwater habitats mentioned below.

To begin with, rather pale and thin, pinkish or brownish snow was encountered several times on late-lying drifts; the only algal organism that could be identified in surface samples of this was the usual "red snow" plant, *Sphaerella nivalis*.

[1] The record of this species from Wolstenholme was inadvertently omitted from Part II, p. 333.
[2] Cf. Part II, p. 339.

Stream beds, although often of uncertain duration and largely barren where rocky, were in some places clothed with dark mosses, or, in one instance, colonized only by little tussocks of *Andreaea hartmanni*. These occurred alike in areas flooded or dry in late August, the earthen banks above being colonized by *Cephalozia fluitans* and *Peltigera scabrosa*. Some sterile filaments of a *Zygnema* were to be found in shallow eddies, and doubtless many smaller Algae occur, but apart from the Diatomeae they were not investigated.[1]

The following Diatomeae were determined by Mr. Ross (*See* Part II) from a single sample taken in the bed of a stream at Wolstenholme on August 24, 1936, when very little water remained:

Achnanthes marginulata
A. minutissima var. *cryptocephala*
Cymbella aequalis
C. angustata var. *hybrida*
C. botellus
C. microcephala
Denticula tenuis var. *intermedia*
Diploneis oblongella var. *ovalis*
Eunotia curvata
E. exigua
E. perpusilla var. *perminuta*
E. praerupta var. *genuina*
E. pseudoparallela
E. tenella
E. triodon
Frustulia rhomboides var. *crassinervia*
Navicula contenta var. *parallela*
N. rotaeana
Neidium bisulcatum
N. iridis var. *ampliatum*
Nitzschia amphibia
N. frustulum
Pinnularia biceps f. *biceps*
P. divergentissima var. *hustedtiana*
P. globiceps var. *krookii*
P. microstauron
Stauroneis anceps var. *amphicephala*
S. perpusilla var. *obtusiuscula*
S. phoenicenteron var. *amphilepta*
Synedra pulchella
S. tabulata var. *delicatula* and var. *obtusa*
Tabellaria flocculosa

In a sample of half-dry seepage scum found on some *Marchantia polymorpha* growing in a rocky chink, it was possible to identify only *Euastrum inerme* and *Staurastrum orbiculare* among fertile filaments of a *Zygnema*.[2]

The margins of lakes in the uplands were often rocky and largely barren (cf. Plate LXXXVIII), although in a few places some semi-aquatic (floating leaves) specimens of *Ranunculus hyperboreus* and *Pleuropogon sabinii* were seen. In the lowland only a few small (and evidently somewhat ephemeral) pools were encountered, again sometimes containing *Ranunculus hyperboreus*.[3] Their shallow or dried-up margins were likely to be colonized by seedlings of *Phippsia*

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[1]In a small freshwater stream at Cape Smith, not so very far south of here, there were found in early August 1936, *Closterium parvulum*, four common species of *Cosmarium*, *Euastrum bidentatum*, *E. binale* and its var. *gutwinskii*, *E. elegans*, *Merismopedia glauca*, *Tolypothrix limbata*, and three common species of *Staurastrum*, as well as the rarer *S. alternans* and *S. vestitum*.

[2] The more promising looking seepage from a stagnant pool near Cape Smith (lat. 60° 42′ N., long. 78° 33′ W.) yielded *Aphanothece castagnei*, *Calothrix parietina*, *Chroococcus turgidus*, *Lyngbya subtilis*, *Merismopedia glauca*, *Microcystis elabens*, *M. firma*, three common species of *Cosmarium*, and four species of *Staurastrum* (including the hitherto undescribed *S. compactum*).

[3] No "Batrachian" *Ranunculus* was seen at Wolstenholme, although *R. trichophyllus* var. *eradicatus* occurred at Cape Smith, whence the record was unfortunately omitted from Part I of the present series.

(Catabrosa) algida and *Koenigia islandica*, or, more extensively, by *Carex aquatilis* var. *stans, Eriophorum angustifolium*, or *E. scheuchzeri*, extending out from the poor marginal marshes described above. The bed supported a few small Algae —in one instance *Closterium striolatum, Pediastrum boryanum* and its var. *longicorne, Scenedesmus quadricaudus*, and *Tolypothrix distorta* var. *penicillata*.[1]

(vii) SEASHORE

As in most other places in Hudson Bay and Strait, the sandy or shingly banks above the driftline at Wolstenholme are often bound by dense beds of *Elymus arenarius* var. *villosus* (approaching var. *villosissimus*), or sometimes more locally by prostrate *Arenaria peploides* var. *diffusa* and *Mertensia maritima* var. *tenella*. Away from the immediate influence of salt water the associated plants became more and more numerous, the first being such hardy species as *Arabis arenicola, Armeria labradorica, Astragalus alpinus, Carex maritima, Cerastium alpinum, Draba nivalis, Festuca brachyphylla, Papaver radicatum, Poa arctica, P. glauca, Sagina intermedia, Saxifraga caespitosa*, and *Silene acaulis* var. *exscapa*. The most characteristic cryptogams appeared to be *Rhacomitrium canescens* and *Stereocaulon alpinum*, both of which exerted a useful binding influence on the sand between the higher plants.

Again similar in composition to the community developed in similar situations elsewhere in the south of our area, was the sandy "saltmarsh" found behind a sheltering bar. Hereabouts the incoming tide met an outgoing freshwater river; the mingling of waters produced a brackish medium. *Puccinellia phryganodes* was the dominant, though its mat was rather thin and allowed a number of associates to attain ecesis. These included *Carex bipartita* var. *amphigena, C. ursina, Chrysanthemum arcticum, Cochlearia officinalis* var. *groenlandica, Koenigia islandica, Puccinellia paupercula*, and *Stellaria humifusa*—but no *Carex salina, Potentilla egedii*, or *Matricaria inodora* var. *nana* was encountered.

Although most of the between-tide range is occupied by barren sands or smooth rock faces, broken rocks or beds of boulders are found in many places around low tide-mark; these are well vegetated by *Fucus vesiculosus* and an abundance of other Algae representing all the main groups and including, chiefly in pools and below low tide-mark, large *Alaria* and *Laminaria* spp.

(9) ISLANDS IN HUDSON AND UNGAVA BAYS

These comprise Southampton (with White)[2], Coats, Salisbury, Nottingham, and Mansel Islands, all in the north of Hudson Bay, and also Akpatok Island in Ungava Bay. Although this last is separated meridionally from the rest by much of the length of Hudson Strait, it lies in similar latitudes and has many more points in common with the Hudson Bay islands than with its adjacent mainland; hence it is not only more conveniently, but also quite legitimately, to be considered with them. The "major district" so constituted extends from 60° 13′ N. to 66° 6′ N., and from 67° 48′ W. to 87° 9′ W. The largest unit by far is Southampton Island, which has an area of approximately 20,000 square miles (cf. Manning 1936, p. 232). Next in size (cf. Bethune 1935, p. 16) come Coats Island ("1,544 square miles") and Mansel ("Mansfield") Island ("1,317 square miles")[3], and then Salisbury Island ("490 square miles") and Nottingham

[1] A single phial taken at much the same time from such a habitat at Cape Smith yielded *Aphanocapsa pulchra, Closterium jenneri, Euastrum bidentatum, E. elegans, Merismopedia glauca, Pediastrum boryanum, Schizothrix fuscescens, Tolypothrix distorta*, three common species of *Cosmarium*, and no less than seven species of *Staurastrum*.

[2] For our present purposes, White and Walrus Islands are considered with Southampton Island, but such other small units as Marble, Vansittart, Winter, Digges, Big, and Killinek Islands are considered with the 'mainland' regions to which they seem more properly to belong, at least phytogeographically. The same fate has befallen Resolution Island.

[3] 975 square miles according to Smith (1932, p. 2), whose figure for Southampton Island would seem to require revision.

Island ("441 square miles"). Akpatok Island is rather smaller (about 300 square miles), being nothing like its supposed size and shape (cf. Polunin 1932, p. 87, and 1934, pp. 339-340; Clutterbuck 1932, p. 217).[1]

The coasts of the islands tend to be rather even in outline, at least compared with those of the adjacent larger land-masses. However, the little known Coats Island has at least one accompanying islet, and Southampton Island has three quite deep indentations. Although practically all surfaces have been smoothed by glacial action and peneplanation, the physiography of the different islands is rather variable; for whereas Akpatok Island is almost surrounded by tall and sheer cliffs and consists largely of plateau undulating around an altitude of about 700 feet (cf. Polunin 1932), and Salisbury and Nottingham Islands are likewise tall-cliffed and rugged (cf. Havergal 1915, p. 230), all these three islands being somewhere around 30 miles (48 km.) long and 18 miles broad, the larger Coats, Mansel, and Southampton Islands are for the most part low and almost flat over considerable areas, even if the last named exceeds 1,000 feet (305 m.) in places in the interior, about the northeast coast, and in its eastern peninsula adjoining Salisbury and Nottingham Islands—cf. Manning 1936, and latest (1945) Canadian 8-inch maps and AAF Aeronautical Charts.

GEOLOGY

The geology of the different islands, and sometimes of different parts of the same island, is quite variable. Akpatok Island "is formed entirely of a horizontally bedded Ordovician limestone series" (Cox 1932, p. 224), the surface being largely occupied by jagged, frost-shattered chunks and splinters of varying size, often without much comminuted "soil". Dark erratic boulders and drumlins of acid-weathering material relieve the monotony of the limestone in some places (*See* Cox 1932, pp. 225-6, and cf. Polunin 1932a, p. 230), but extensive deposits of sand and silt are largely restricted to valleys near the sea.

The closely adjacent Salisbury and Nottingham Islands have not been properly investigated, but, as Weeks has recently remarked (1935, p. 143), "from their rugged appearance there is very little doubt that they are composed of earlier crystalline rocks, probably granitic and gneissic rocks similar to those found on adjacent islands" (cf. Bell 1884, p. 28DD, and Havergal 1915, p. 230).

Southampton Island is much better known, having been an objective or at least a calling point of numerous expeditions. The southwestern two-thirds of the island is predominantly low and flat and of limestone that "ranged in age from the Ordovician to high in the Silurian" (Weeks 1935, p. 143). The rest of the island, including almost the whole of the long northeastern coast, and in addition much of White Island, is of higher and more rugged, gneissic country (cf. Parry 1824, p. 38, Mathiassen 1931, pp. 13 *et seq.*, and Manning 1936, p. 236).

To the south and southeast lie Coats and Mansel Islands. The former is unmapped and little known, but appears to consist largely of limestone, although there is said to be a "narrow ridge" of granitic rocks running across it near the northeast end (cf. Weeks 1935, p. 143), and certainly the northeastern extremity looks dark and rugged from the sea or air. Mansel Island is better known; like Akpatok, its main substance is evidently of horizontally bedded limestone (Bell 1884, p. 33DD), but, again like Akpatok and most other limestone areas around, the surface is almost entirely occupied by loose, frost-shattered debris (Bell *l.c.*, and cf. Polunin 1938b, p. 6).

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[1] See footnote (2) on p. 239.

CLIMATE

Little is known of the climate of Akpatok Island, except that it is a very exposed place, often foggy and cool in summer (cf. Polunin 1932), and probably somewhat oceanic in type, although certainly not as markedly so as Resolution Island. Thus, there may frequently be a humidity as high as 90 per cent. even in the absence of rain, and little difference in day and night temperatures (cf. Clutterbuck 1932, pp. 221-2). As to the islands in Hudson Bay, we have more reliable meteorological data from Nottingham Island, including that given below, which shows that the climate just here is not altogether dissimilar from that of Lake Harbour (cf. p. 132), although on the whole less favourable, especially in temperature relationships. Thus, only a single month, August, is generally without frost, rain does not normally fall until June, and the total annual precipitation is slightly less (about 13 inches) than at Lake Harbour. Farther west, in the manner indicated by Connor (1930, especially maps on pp. 5 and 8), the climate becomes more and more severe in winter and 'continental' in general, as already suggested by the appended figures taken over irregular monthly periods during 1934 and 1935 at Coral Harbour in South Bay, Southampton Island.

Month	Nottingham Island, 63° 6′ N., 77° 56′ W. Average 1931-4					Coral Harbour, 64° 8′ N., 83° 10′ W. Monthly periods during 1934-5				
	Temperature °F.			Precipitation		Temperature °F.			Precipitation	
	Max.	Min.	Monthly mean	Inches	S or R	Max.	Min.	Monthly mean	Inches	S or R
Jan.	12	−33·5	−15	0·46	S	4	−46	−24	0·23	S
Feb.	9	−37	−17	0·33	S	7	−51	−24	0·5	S
March	20	−29	− 6·5	0·55	S	8	−45	−19	0·04	S
April	35	−14	9	1·01	S	30	−33	3	0·3	S
May	40	2	26	0·84	S	35	−20	17	0·19	S
June	54	24	36	0·74	S and R	57	10	35	0·63	S and R
July	62·5	31	44	1·08	R	73	32	47	1·65	R
Aug.	61·5	33	44	2·41	R	63	32	44	4·8	R
Sept.	50·5	24	35·5	2·13	S and R	51	9	32	3·69	S and R
Oct.	38	11	62·5	1·16	S and R	33	−19	18	0·72	S
Nov.	29	−13	10	1·20	S	30	−26	− 1	0·2	S
Dec.	17	−29	− 8·5	0·85	S	13	−56	−23	0·03	S

VEGETATION

Of the remarkably poor but intensely interesting vegetation and rather meagre flora of Akpatok Island, on which I spent a month during the Oxford University Expedition of 1931 while an undergraduate of Christ Church, I have already published detailed accounts in scientific journals that are in general circulation (cf. 1934, pp. 337-395, 1934a, pp. 197-204, and 1935, pp. 161-209). Accordingly, it will be unnecessary to give more than a few guiding remarks here, although it should be mentioned that the determinations of the species employed in those accounts, made in my absence by others, have in many cases had to be revised (*See* Journal of Ecology, XXV, p. 570, 1937; the promised revisions are incorporated in Parts I and II of the present series).

In the general absence of proper control of the surface by the very meagre plant "covering", the vegetation of Akpatok could only satisfactorily be considered in terms of "habitats"—as has indeed been done in this present work

almost throughout our Eastern Arctic area. On Akpatok, twelve main types of habitats (or in some cases "special communities" which stood out sufficiently to affect the landscape locally, or at least to characterize their area) were recognized as between them occupying virtually the whole of the terrain. These were as follows.

I. *Hilltops*, rising to a maximum of 930 feet (283 m.) and supporting only a very few plants in sparsely open formation. When the terrain is extremely exposed and occupied by jagged limestone particles, as is frequently the case, crustaceous lichens (especially Lecideae) are often the only colonists of their blizzard-eroded surfaces. In other instances a modicum of more finely comminuted material may occur at the surface and support an occasional plant of *Salix arctica* or *Dryas integrifolia*, or, rather less frequently, of *Saxifraga oppositifolia* (apprg. f. *pulvinata*), *Polygonum viviparum*, or *Draba alpina* var. *nana* (Polunin 1934, pp. 350-2, and cf. 1932, plate facing p. 170).

II. *Plateau*, of limestone polygon, 'fjellmark', or other surfaces. These between them cover most of the area of the island, the plateau undulating gently between the altitude limits of 500 and 800 feet. The vegetation is again a rather sparsely open "barren" in most places, although far less depauperated than on exposed hilltops—at least in the "intervening tracts" between polygons where these occur. The chief plants are hardy, "open soil" calcicolous and other species such as *Arenaria rossii, Carex misandra, Dryas integrifolia, Salix arctica* and *S. calcicola, Saxifraga aizoides, S. oppositifolia*, and the like. *Carex misandra* is usually the tallest plant, sometimes exceeding 7 inches (17·8 cm.). Cryptogams grow well only in the tufts of "higher" vegetation. (*See* Polunin 1934, especially pp. 360-6, and Pls. XXIX, photo 6, and XXX, photo 10.)

III. *Screes and Other Slopes.* These are numerous and variable, the surface being frequently dynamic and the vegetation, consequently, poor. The chief stabilizers are again patches of *Dryas, Salix* spp., or matted *Cerastium alpinum* or *Saxifraga oppositifolia* (Polunin 1934, pp. 367-75, and Pls. XXXII, photo 15, XXXIII, photos 17-20, and XXXIV, photos 21 and 22).

IV. *Ravines*, traced from plateau to sea. The beds are generally barren and the sides may be so too, though they are very variable in type and sometimes relatively well vegetated (Polunin 1934, pp. 376-7, and Pls. XXIX, photo 8, XXXIII, photo 18, and XXXV, photos 25-7).

V. *Valley Sides.* Here there is shelter and frequently some soil, the surface being well vegetated, with the ground usually darkened by more or less continuous heathy or grassy communities, most frequently dominated by *Dryas* or *Cassiope*. The associated phanerogams and cryptogams are numerous, very various, and almost always of good growth (Polunin 1934, pp. 377-80, and Pl. XXXVI, photos 28 and 29).

VI. *Valley Heads and Depressions.* Boggy depressions and marshy zones around lakes are often vegetated by closed communities dominated by Carices (especially *C. membranacea*) and Eriophora (especially *E. angustifolium*), which in the most sheltered localities may be quite luxuriant and extend out into the water. As elsewhere in our area, *Arctagrostis latifolia* and *Eriophorum scheuchzeri* are other typical dominants of marshy areas (Polunin 1934, pp. 381-3, and Pl. XXXVI, photo 30).

VII. *Snow Effect*, in "swallow holes" and late or persistent patches. A series consisting of as many as six subclimax zones is frequently to be seen, the peculiar localized communities developed in relation to drifted snow including a

"herb tangle", a *Cassiope* heath, a *Salix herbacea* mat, a mixed herb barren, and a limited moss mat (Polunin 1934, pp. 383-91, and Pls. XXXVII, photos 31-3, XXXVIII, photos 34-5, and XXXIX, photo 36).

VIII. *Erratic Boulders,* of mica schist, etc. These in different places are variously vegetated by successional stages of lichens and mosses, usually much more luxuriantly than the general limestone. On large boulders in sheltered situations the cryptogams may even afford a *nidus* for the ecesis of higher plants (Polunin 1934, pp. 391-4, and Pl. XXXIX, photos 37-8; also 1935, Pl. XVII, photo 2).

IX. *Special Localized Communities,* in which the vegetation is always closed and relatively luxuriant—hence notable. Several types are distinguished, vegetated by mixed forbs, grasses, or heaths (including *Empetrum, Rhododendron,* and *Vaccinium uliginosum* var. *alpinum*), or comprising moss mats or marshy "hillock tundra" areas (Polunin 1935, pp. 161-72, and Pl. XVII, photo 1).

X. *Special Localized Habitats.* Of these, two main types are described—the acidic moraine accumulations that are generally darkened by closed vegetation and contrast strikingly with the light colour of the surrounding limestone plateau, and the environs of bird-cliffs that support thickly matted, grassy or cryptogamous communities of the type described above from Cape Wolstenholme (*See* especially Polunin 1935, pp. 172-8, and Pls. XVII, photo 3, and XVIII, photo 4; also 1934, Pl. XXXI, photo 13).

XI. *Freshwater Habitats.* The streams and tarns were variable but generally rather barren, being often ephemeral or subject to drastic fluctuations in height. The chief phanerogamic aquatics or functional aquatics are *Pleuropogon sabinii* and *Ranunculus hyperboreus, R. trichophyllus* var. *eradicatus* being rare (Polunin 1935, pp. 179-83).

XII. *Marine Habitats.* Various diminutive Algae in places clothe the stony bed of a tidal lagoon, but the shore plants are fewer than in most adjacent mainland regions, and the between-tide rocks are more barren. The marine plankton was abundant in late summer, as shown by dredging in 1931, and the benthos was extremely luxuriant, including specimens of *Laminaria longicruris* de la Pylaie[1] up to 47 feet in length. (*See* Polunin 1935, pp. 184-91, and Pls. XVIII, photos 5-7, and XIX, photos 8-10.)

Of the vegetation of Nottingham and Salisbury Islands very little is known, although from the former I have seen so many specimens (*See* Part I), and from the latter have been sent such a collection (*See* Canadian Field-Naturalist for January 1940, pp. 9-10), as to indicate that they are not as barren as is suggested by Havergal (1915, p. 230); already Smith (1932, p. 56) has noted that on Salisbury Island the vegetation "is more prolific than on Mill Island, both grass and moss occurring in the valleys." Although the twenty-one species of vascular plants now known to grow on Salisbury Island are all of widespread arctic or sub-arctic distribution, "the indications are that the soil in places is relatively rich, the growth of some plants being quite luxuriant in spite of the exposed situation, so that this figure probably still represents only a small portion of the actual flora" (Polunin 1940a, p. 10).

Mill Island, to the northwest of Salisbury Island, and some other smaller islands situated between these two, are said to consist "of massive igneous rocks rising abruptly from the sea. These are worn by ice action and beyond a few

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[1] Not mentioned in Part II of the present series, where Dr. Whelden's account of the Algae (apart from Marine Phytoplankton and Freshwater Diatomeae), unlike most others, was unfortunately based merely on my collections of 1934 and 1936.

grassy valleys are practically devoid of vegetation" (Smith 1932, p. 55), which may yet mean that on them plant growth is comparatively luxuriant. Concerning the geographical and physiographic features of Mill Island and its adjacents, some useful notes are contributed by Putnam (1928, pp. 9 *et seq.)* and Gould 1928, pp. 28-9).

Southampton Island is relatively well known, the vegetation and ecology being no exception to this. A detailed account of the main plant communities occurring in one district, on both gneissic and limestone substrata, being given below, it will suffice here to offer a few of the more pertinent details available from other parts of the island. Of the northern part, particularly around York Bay, Parry writes (1824, pp. 39-41) "In the fissures and hollows between the rocks, the moss, sorrel, ground willow, and a few other plants were abundant... this land, which rises gradually from the beach, but is in no part more than sixty or seventy feet above the level of the sea, was full of ponds of fresh water, and in almost all the intermediate parts there was abundance of fine vegetation, consisting of grass, moss, and various other plants, of which specimens were brought on board".[1] On one part of the east coast where "the rocks seemed to be a striated granite singularly placed," Back (1838, p. 190) noted, though admittedly in winter when observation is difficult and may be misleading, "so little soil, that only in five or six places did I observe any symptoms of vegetation, if short thin grass and a few yards of moss even deserve the name". In more general vein Bell notes (1884, p. 34DD) that "much of the surface has a brown colour in consequence" (of the vegetation), and Comer (1910, p. 86) says rather fancifully that "The low lands produce an abundance of grass, waving in the winds like the wheat-fields of the temperate zone; in the higher altitudes, of course, there is little vegetation—sedges border the ponds".

The recent general travellers on Southampton Island include T. H. Manning, who tells me that his (1936, pp. 236-7) "terraced limestone plateaux" and "largest and most consistent tracts of marsh" occurring in the southwest, east, north, and probably elsewhere (cf. p. 241) are much like the limestone area and many of the marshes around the place at the head of South Bay described below, and Therkel Mathiassen, whose "remarks on the vegetation in general" (1931, pp. 25-6), under the heading of "Flora", are little more illuminating. However, he does imply that *Dryas* or *Saxifraga oppositifolia* barrens of one sort or another cover a large part of the total area, with associated *Salix*, etc., species, and that in parts the interior "has almost the character of a desert, without any vegetation at all or only very little—a few small tufts of *Dryas* which have been able to take root in the crevices." On the other hand "In the large flat and partly swampy areas in the interior, such as around Cleveland River, the vegetation is more marked, with many grasses . . . , Cyperaceae . . . and *Salix* species; along the banks of Cleveland River I often saw a narrow belt of knee-high willow thicket" (Mathiassen 1931, p. 25). This was all on limestone terrain. Of gneissic areas Mathiassen says little that is of use to us, as most of his travelling was done in winter, except that the northern part of White Island has "the usual poor mountain heath . . . of lichens and mosses, interspersed with herbs and dwarf bushes such as *Salix*, *Vaccinium uliginosum* (small,

[1] Most of these specimens I have seen (cf. 1938a), but they are not suggestive of a really luxuriant vegetation, any more than is Lyon's account (1824, pp. 48-9) of a landing place at the south end of York Bay, where "the few stunted willows" rose "three or four inches from the ground".

without berries), *Empetrum, Cassiope tetragona, Saxifraga* species . . . , *Papaver, Pedicularis, Dryas, Oxyria, Melandryum,* a few pretty, bright-coloured flowers such as *Chamaenerium*[1] and *Gentiana*[2], grasses and Cyperaceae, the latter mostly in moist places" (*ibid.*, p. 26).

Low's account of the low-lying limestone terrain near the west coast is probably characteristic of many similarly constituted coastal areas elsewhere. He writes (1906, pp. 33-4) "The land behind rises in a succession of ridges each a few feet higher than the one immediately in front. The ridges are formed of broken limestone, evidently the surface portion of underlying ledges. Very little vegetation grows on the ridges, but in the wide depressions between them there is a profusion of grasses and other Arctic plants on the wet ground surrounding the many ponds and lakes found there".

It was apparently somewhere off this west coast that Lyon (1825, p. 115) "passed a great quantity of tangle-weed . . . The stalk of one piece which we measured, was eighteen feet in length, and the leaf, although a portion had been torn from its point, twelve feet six inches, making a total of thirty feet six inches". The beds of which Lyon spoke were evidently growing attached, and the species was probably *Laminaria longicruris,* which reaches a length of at least 47 feet (14 m.) around Akpatok Island (Polunin 1935, p. 191).

Latterly, Mr. Pat Baird has been kind enough to give me some account of his collecting activities in the southern parts of Southampton Island and on the closely adjacent Walrus Island. This last is rocky and only about 1 by $\frac{1}{3}$ mile, rising to a maximum elevation of some 150 feet (46 m.). Almost the whole island is of rock, but there are some patches of rather damp soil in depressions. On these the vegetation is often closed, and either heathy, dominated by *Empetrum* (no *Cassiope* was seen on Walrus Island), or marshy, with dry tussocks characteristically bearing *Rubus chamaemorus* (of which Mr. Baird produced good specimens). On the southwest coast of Southampton Island, at Nuksharngnaq (Noksarnak, lat. 63° 27′ N. in the Bay of Gods Mercy), the terrain consists mainly of a "series of raised beaches with marshy depressions" in which the vegetation may be closed. Inland are more gravelly ridges and large areas of polygons and up-ended splinters that make travelling rather tiresome, just as on Akpatok Island (cf. Polunin 1932, p. 166). *Dryas* is the chief plant, with some *Carex misandra* and Salices. On the most exposed ridges, e.g., of the Nuvudlik (Nuvoodlik) Hills, *Saxifraga oppositifolia* may be the only flowering plant, but in more favourable places (where there is sometimes a loosely closed *Dryas,* etc., "heath"), *Pedicularis lanata* and *Saxifraga tricuspidata* are usually associated. Much the same conditions and vegetation persist around Cape Low in the extreme south of this island, which is about 216 miles in length from east to west and 200 miles from north to south (cf. Manning 1936).

In August, 1946, I revisited Coral Harbour, the district of South Bay whose vegetation is described below, and flew over various other parts of Southampton Island; although on these occasions visibility was often very poor, it is, nevertheless, possible to fill in some of the previous 'gaps' in our knowledge. The southern part of Bell Peninsula, comprising the extreme southeast of Southampton Island, is of light-coloured limestone that contrasts markedly with the dark hills to the north. The monotony of this flat limestone country seems from the air to be relieved more by rather numerous shallow lakes than by any real

[1] I.e., *Chamaenerion,* probably referring to *Epilobium latifolium.* (N.P.)

[2] Evidently a mistake, no *Gentiana* being known from Southampton Island or its immediate environs—cf. Grøntved 1936. (N.P.)

show of vegetation. Nor are there the deep ravines so characteristic of the generally much higher Akpatok Island (*See* before). Over some considerable tracts there appeared from altitudes of around 4,000 feet to be practically no vegetation, though more often between one-quarter and one-half of the total area was intermittently bound by contrastingly dark growth, which in some places looked almost continuous. These most favoured tracts were usually in sheltered depressions and consisted apparently of heathy or marshy communities, according to local water conditions. The surface materials of the limestone plains appeared to be all loose and comminuted, frost-shattered to comparatively small sizes. Light-coloured polygons showed up in places, especially near lakes, which themselves were relatively dark and apparently well vegetated, particularly around their margins. Some of these lake margins, which from the air looked greenish with Algae, showed long solifluction streaks that even extended down into the water, well beneath its current level. The limestone country as a whole appeared from the air to be abundantly dissected and streaked, with beach-lines and ridges rising inland as steps—sometimes lying parallel with one another for considerable distances, but more often without evident order or regular direction. Further dissecting influences were streams and dried-up watercourses.

To the west-northwest, around Coral Harbour, the rocks are darker and acidic, with lakes more numerous and vegetation almost continuous over considerable tracts. West of Coral Harbour, again, the country is largely of limestone, being low and only sparsely vegetated. Indeed the light-coloured plains about the mouth of Kirchoffer River looked desert-like in their undulating monotony. But where the bedrock was darker and acidic there was evidently more luxuriant vegetation, which often appeared almost continuous over considerable areas—except on grey rocky outcrops that looked scoured and largely barren. Where the terrain was sandy or of more stable limestone, which had been longer out of the sea than that near the coast, the country was about half covered with patches of more or less continuous 'higher' vegetation. Still farther inland, to the west, the rocks appeared largely acidic and the vegetation almost continuous—mostly of various shades of brown or yellow-brown, interrupted by shallow lakes that were rarely at all large. Then again farther west there was a change to more barren limestone, though even on this the patches of darker vegetation were sometimes confluent over considerable areas of low-lying, marshy plains.

To the north of Coral Harbour much of the country is tolerably well vegetated, though rarely without some light-coloured barren tracts or poorly colonized rock. Lakes are numerous and not always small. But about the higher, exposed north coast persistent snow-patches were numerous and relative barrenness prevailed. Hereabouts the sea rarely if ever becomes entirely free from ice. At best the grey and rocky hills as seen in late August had a yellowish brown mellowing of vegetation. In places the streams have cut deep and narrow gorges; but the occasional sandy flats in the more open valleys looked greenish yellow with vegetation. This became more noticeable as one flew south again, and the country gradually became lower and smoother—the stream beds shallower and the hills less steep and rocky.

Around the mouth of the main southern tributary of Kirchoffer River, for which tributary the name Manning Brook is being proposed, I made more intensive observations during a walk inland from the coast. Hereabouts the general country proved fairly well vegetated, with extensive marshes and more limited heaths. Scattered and individually spreading shrubs of *Betula glandulosa* var. *sibirica* were found in several places, as were larger ones of *Salix alaxensis*

and *S. richardsoni* var. *mckeandii,* but although the willows, especially, often grew in such close proximity that from afar the covering looked complete, no extensive consolidated scrub was encountered. In sheltered valleys, especially by streams, the willows formed domed bushes up to a metre high and 4 m. in diameter, with prostrate axes sometimes exceeding 10 cm. in thickness. Hereabouts the plains frequently supported a continuous investment of mixed heathy vegetation, the flora of the river valleys though far inland included some typical sea-side plants, and there were found several angiosperms not previously known to occur on Southampton Island—including a new *Antennaria* (cf. Polunin MS.o, Chapter XXI).[1]

Finally, I should add some notes on the limestone terrain surrounding the new airfield west of Coral Harbour, where the ground was smooth and gently undulating, the surface porous and usually arid. Much of this semi-desert of frost-shattered particles ranging from gravel size upwards was devoid of 'higher' or even any evident vegetation, but usually a few depauperate Saxifragae, Drabae, or Arenariae, or tufts of *Dryas* or *Papaver* were to be found, with xeromorphic Carices or prostrate Salices where slight shelter allowed. On the most exposed "barrens" the chief and sometimes the only plant to be seen was *Saxifraga oppositifolia,* growing in sparsely scattered tussocks usually 5-15 cm. in diameter, the associates being typically *Lychnis apetala, Cerastium alpinum, Braya purpurascens, Papaver radicatum, Draba alpina* var. *nana,* and *Arenaria rubella.* A close search over many square metres would frequently reveal little more in the way of plant growth, the cryptogams being few and even the 'dominant' *Saxifraga* very little in evidence among the jagged limestone splinters with rough eroded surfaces. The occasional erratic boulders or even small stones were, however, almost always better vegetated with crustaceous lichens.

The slightest change to a more sheltered situation tends to be accompanied by a larger flora, including such lichens as *Cetraria nivalis, C. cucullata,* and *C. islandica* s.l., with usually some *Dryas,* the whole passing with improved conditions to a *Dryas* barren or even closed heath. The associates here include *Carex misandra, C. rupestris, C. scirpoidea, Salix arctica, Kobresia simpliciuscula, Polygonum viviparum,* and sometimes a little *Cassiope tetragona.* The *Dryas* forms tussocks of varying size up to half a metre in diameter, which tend to be larger toward the bottoms of banks or depressions, and harbour or actually support most of the associated angiosperms and relatively luxuriant and exacting cryptogams. In more favourable and sheltered depressions, *Cassiope* forms a fair heath, sometimes with associated *Arctostaphylos, Rhododendron, Lycopodium selago, Salix herbacea, S. reticulata,* etc. In still more favoured, damp depressions and lake-side habitats there grow contrastingly luxuriant bushy willows and fine beds of Eriophora and Carices, often extending far out into shallow water. The more important dominants and characteristic associates in these marshes on the limestone include *Arctagrostis latifolia, Carex aquatilis* var. *stans, C. atrofusca, C. bicolor, C. membranacea, Chrysanthemum integrifolium, Deschampsia brevifolia, Epilobium davuricum* var. *arcticum, Equisetum variegatum, Eriophorum angustifolium, Juncus albescens, J. biglumis, Saxifraga aizoides, S. hirculus,* and *Senecio congestus* var. *palustris (S. palustris).*

Coats Island, as has already been mentioned above, is much less known than Southampton Island, although both have been advocated by a Royal Commission and set aside "for the purpose of providing grazing grounds for reindeer and musk-ox" (Anon. 1922, p. 25). From what Mr. A. E. Porsild of Ottawa

[1] For details, *See* my recent account of "Additions to the floras of Southampton and Mansel Islands, Hudson Bay" (Contributions from the Gray Herbarium of Harvard University, No. CLXV, pp. 94-105, 1947).

has told me of his observations made during a brief visit to Coats Island in the summer of 1930, and from what I have been able to see from the sea, it would appear that the vegetation is in general closely comparable with that of Southampton Island, which indeed is near and in many ways similar. However, from what I have heard from other sources about the low marshes inland of Cary's Swan Nest in the extreme south, it may be that the vegetation is there more luxuriant than almost anywhere on Southampton Island. According to Captain Henry Toke Munn, Coats Island supports "the fattest caribou in the Canadian Arctic", although it is said that they have recently been almost (or perhaps entirely?) exterminated by the Eskimos of Southampton Island.

Finally we come to Mansel Island, which has also been set aside as a grazing ground. All that was known about its botany I once gathered together in a little paper (1938b, pp. 5-9), suggesting that this island would probably prove less suitable than the others for the allotted purpose. Thus we must discount the suggestion of Low (1906, p. 37) and instead conclude that the vegetation is in many places extremely poor; indeed quite possibly it may be so almost everywhere. Such was the implication of Bell (1884, p. 33DD) as regards the east and south coasts, and this has more recently been corroborated for the northern end of the island by Mr. Douglas Leechman of the National Museum of Canada (*See* Polunin 1938b, pp. 6-7). The island is said to be composed entirely of limestone and to be very low, rising to at most 300 feet (91 m.) in the centre; the usual thing, at least near the sea, is to find ridge upon ridge of low banks of limestone shingle, the raised areas being almost entirely barren and the depressions often not much colonized, although occasionally supporting strips of heathy or marshy vegetation. Pools are numerous and tend to be surrounded by a continuous sedgy-grassy community, but even this is usually of small extent. Mr. Leechman tells me that inland the country at the north end is low and flat and covered with limestone detritus supporting little except occasional close pulvini or small dark mats of *Dryas integrifolia* or *Saxifraga oppositifolia*. Only the marshy depressions are at all extensively covered with vegetation; they are generally dominated by Carices, Eriophora, and *Arctagrostis latifolia*—all of rather poor growth and liable to interruption by hillock tundra. It is said that in the central region there are larger tracts of vegetation capable of supporting caribou, although it is doubtful if there have ever been many on the island.

Plant Communities Around Coral Harbour, Southampton Island

The Hudson's Bay Company's trading post in South Bay is situated in latitude 64° 8′ N. and longitude 83° 10′ W. in the terminal bay 'Coral Harbour'. The terrain here is flat and monotonous (Plate XCVII), relieved chiefly by numerous lakes and low rocky ridges, and by higher country inland, to the north. The rocks forming the low plains are principally gneisses, but they are covered in most places by coarse, rewashed glacial material and finer marine clays. These deposits are all more or less calcareous, often containing a considerable proportion of admixed limestone and marine shells. The "higher country inland" is of gneiss; but between these types of terrain lies a low isolated plateau of limestone, whose vegetation will be described below. Some account of the severe climate of Coral Harbour has been given above (p. 241). It is moreover an exposed and almost perpetually windy place; nevertheless, the summer is sufficiently favourable to allow radishes to attain a useful (almost normal) size even without glass, and lettuces to grow to a height of 7 cm. (in 1934).

PLATE XCVI

Barren, light-coloured "polygons" and their darker, well-vegetated intervening tracts on flat area of limestone plateau. Inland of Coral Harbour, Southampton Island, Aug. 22, 1936.

PLATE XCVII

Typical plains near the coast. In depressions are lakes surrounded by luxuriant marshes; on dry areas heaths are dominant, but they thin out to dark, lichen-covered rocks on exposed ridges (as in the foreground). The rocks are here acid-weathering. Coral Harbour, Southampton Island, Aug. 25, 1934.

(i) RAISED AREAS

These in the vicinity of the post and for some distance inland lack distinction, being generally only a few dozen feet above sea-level, or, at most, above the surrounding land. They are of two main kinds:

I. Rocky ridges and protuberances of gneiss that has been smoothed by glacial or wave action and, except in occasional crevices, supports little but cryptogams (*See* Plate CI). The chief of these are crustaceous and foliose lichens —especially numerous species of *Lecidea*, *Lecanora* and *Parmelia*—which contribute to the rather dark colour of the surface (Plate XCVII in the foreground, and Plate XCVIII), and the moss *Rhacomitrium lanuginosum*, which may form luxuriant silvery grey mats anywhere that it can get a hold.

PLATE XCVIII

Exposed rock surface well vegetated by lichens and mosses—including two tufts of ***Rhacomitrium lanuginosum*** showing central retrogression to crustaceous lichens (on left) and ecesis of a herb (***Festuca brachyphylla***, on right). Pipe gives scale. Coral Harbour, Southampton Island, Aug. 25, 1934.

II. Low limestone plateau a few miles inland. The surface is of loose material including many marine shells and, according to Messrs. Pat Baird, G. W. Rowley, and T. H. Manning, is altogether very like that of the areas described by the last named (1936, p. 236) as occupying much of the more westerly limestone regions that comprise some two-thirds of the total area of Southampton Island. The vegetation on this plateau is in many ways reminiscent of that of the higher and more exposed limestone plateau of Akpatok Island (cf. Polunin 1934, pp. 352-367, and Pls. XXVIII, photo 4, XXX, photo 10, and XXXII, photo 16), being often of rough, frost-shattered *Dryas* or *Saxifraga oppositifolia* "barrens" containing only a few diminutive phanerogamic associates and comparatively few cryptogams. Lower examples from the vicinity of the airfield a few miles to the west of the post are described on p. 247. More typical, however, of those parts I have visited inland are barren "polygons"

separated by rather well vegetated intervening tracts (Plate XCVI), the sorting of the material and differentiating of the areas being due to frost action (*See* Polunin, *l.c.*).

The intervening tracts being often unusually broad for such terrain, the roughly rounded "polygons" typically cover only a little more than half the total area. Their centres are very slightly domed and mostly of finely comminuted material—largely clay—but small stones generally comprise the surface at the periphery. The polygon surface is as a rule perfectly barren, being obviously dynamic from season to season. However, depauperated individuals of the following angiosperms may occur in places, none having a frequency degree of more than "r" or, except in the case of *Saxifraga aizoides*, at all regularly attaining the flowering state:

Braya purpurascens
Carex nardina
Deschampsia brevifolia
Draba alpina var. *nana*
D. subcapitata ?
Polygonum viviparum
Puccinellia vahliana
Saxifraga aizoides
S. oppositifolia

Individual polygons, which average about 1½ m. in diameter, may be devoid of even a single seedling of a higher plant; cryptogams also are usually absent from the clayey centre, but a close search of the larger limestone particles toward the periphery will generally reveal a few very small crustaceous lichens or greenish algal investments.

The intervening tracts are very irregular (*See* Plate XCVI), but average about 40 cm. across. Although including most of the larger stones of the surface, they are vegetated by a closed mat of higher plants and thus form a continuous though patchy looking network. *Dryas integrifolia* is the most plentiful plant, forming domed tussocks often 20 cm. high with a core of dark brown humus, but in the "best" places calcicolous Salices (generally the apparent hybrid *S. calcicola* x *richardsoni* var. *mckeandii*) predominate, forming small gnarled bushlets up to 30 cm. high. These may again be overtopped by occasional axes of *Carex misandra*, which reach nearly 40 cm. in height. Thus the whole is much better vegetated than the polygoniferous terrain or most other plateau areas on Akpatok Island—and also, it may be, than most other limestone regions of Southampton Island.

The intervening tracts gave the following list of vascular plants from a small area, the barren polygons being ignored in the assignment of frequency degrees:

Salix cf. *calcicola* x *richardsoni* var. *mckeandii*	ad
Dryas integrifolia	va
Carex misandra	a
Kobresia simpliciuscula[1]	a
Carex nardina	f
C. scirpoidea	f
Polygonum viviparum	f
Carex rupestris[1]	o-f
C. vaginata	o
Equisetum variegatum	o
Salix reticulata	o
Saxifraga aizoides	o
S. oppositifolia	o

[1] Frequently parasitized by *Cintractia caricis*.

Arctagrostis latifolia	l (in damp depression)
Carex membranacea	l (in damp depression)
C. atrofusca	l (in damp depression)
Eriophorum angustifolium	l (in damp depression)
Juncus biglumis	l (in damp depression)
Braya purpurascens	r
Chrysanthemum integrifolium	r
Pedicularis capitata	r
P. hirsuta	r
Salix arctica	r
Arenaria rossii	vr
Draba alpina	vr

Cryptogams are not much in evidence, though a number of Cetrariae[1] and other lichens occur, and mosses of tussocky growth contribute to the closely matted nature of the strips of higher vegetation. These insulate the gravelly soil, so that beneath the surface it is generally quite damp although well drained. The polygons are chiefly developed in comparatively (but not quite) dry areas. In damp depressions there may be a properly continuous though poor marshy community, and erratic deposits of acid-weathering material even in exposed situations are often still better vegetated, supporting a rich heath dominated by *Cassiope tetragona*, etc.—with such associates as *Hierochloe alpina*, *Luzula confusa*, and "reindeer-moss" Cladoniae, none of which is normally to be found on the limestone.

(ii) GENERAL PLAINS

The plains cover most of the area, and their communities are far more variable from place to place than their flat terrain would lead one to expect. The vegetation types fall into two main series, of which the first is a marshy tundra that seems most conveniently treated in (iii) below, and the second is heathy and more or less lichenous. *Dryas* is usually the chief plant here, with or without associated (or sometimes locally dominant) *Arctostaphylos rubra*, *Cassiope tetragona*, *Empetrum nigrum* var. *hermaphroditum*, *Ledum palustre* var. *decumbens*, *Rhododendron lapponicum*, Salices, *Vaccinium uliginosum* var. *alpinum*, and *V. vitis-idaea* var. *minor*. A typically variable but on the whole rather poor area, in which there were both exposed gneiss surfaces and damp muddy depressions, gave the following heterogeneous looking list:

Dryas integrifolia[2]	vad
Carex rupestris	a
C. nardina	f-a
Oxytropis maydelliana	r-a
Vaccinium vitis-idaea var. *minor*	la
Oxytropis arctobia	f
Poa arctica	f
Polygonum viviparum	f
Saxifraga tricuspidata	f
Oxytropis hudsonica	o-f
Salix arctica	o-f
S. reticulata	r-f
Pedicularis capitata	l
P. lanata	l
Arctostaphylos rubra	o
Luzula confusa	o
Saxifraga oppositifolia	o[3]
Stellaria longipes	o
Cerastium alpinum	r

[1] Including good *C. nivalis* on the tops of the larger tussocks where there can be little if any snow-covering in winter.

[2] Including some f. *intermedia* in sheltered situations, where the leaves were often four or five times as broad as in exposed places.

[3] More plentiful and of far better growth on bare, gravelly patches nearby.

Draba alpina var. *inflatisiliqua*	r
D. glabella	r
D. nivalis	r
Festuca brachyphylla	r
Saxifraga cernua (incl. f. *latibracteata*)	r
S. nivalis	r
Silene acaulis var. *exscapa*	r
Arenaria rubella	vr
Cardamine bellidifolia	vr
Carex scirpoidea	vr
Draba cinerea	vr
Epilobium latifolium	vr
Poa glauca var. *tenuior*	vr
Braya sp.[1]	(1)
Tofieldia pusilla (*T. borealis*)	(1)

Although the area was of more than my usual 5-metre quadrat, and moreover included different facies, this list is surprisingly long, especially in view of the fact that close tussocks of *Dryas* occupied about two-thirds of the whole. Nevertheless it is typical and instructive. The most important cryptogam is *Rhacomitrium lanuginosum*, whose luxuriant mat may spread out over rock faces and constitute a rapidly advancing stage in the xerosere. Many other cryptogams were also to be found in the area, including parasitic Fungi. They principally comprised the following, in whose collection I was assisted by King Scout McCallum, of Winnipeg:

BRYOPHYTA	*Aulacomnium turgidum*
	Dicranum elongatum
	D. groenlandicum
	Hypnum revolutum[2]
	Lophozia attenuata
	Orthotrichum laevigatum
	Pseudoleskea sp. ?
LICHENES	*Alectoria chalybeiformis*
	A. nigricans
	Caloplaca elegans
	Cetraria crispa[2]
	C. cucullata
	C. nivalis
	Cladonia elongata
	C. lepidota f. *stricta*
	C. mitis
	C. pyxidata var. *pachyphyllina* ?
	C. uncialis
	Dactylina arctica
	Ochrolechia frigida
	Parmelia austerodes
	P. infumata
	P. omphalodes
	P. saxatilis
	P. separata
	Pertusaria dactylina
	Physcia muscigena
	Sphaerophorus globosus
	Stereocaulon alpinum
	Thamnolia vermicularis
FUNGI	*Cintractia caricis* on *Carex rupestris*
	Peronospora parasitica on *Draba nivalis*
	Pseudopeziza drabae on *Draba nivalis*[3]

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[1] Labelled "cf. *B. glabella*" and so reported in Part I, pp. 249-50, but according to Porsild (1943, pp. 45-6) nearer to *B. pilosa* Hook.

[2] The record of this species from Coral Harbour was inadvertently omitted from Part II of the present series.

[3] Also found on *D. fladnizensis* s.l. near by.

Some of the above lichens were largely confined to projecting rocks, on which there were also a host of additional small Lecideae and other crustaceous forms, but the majority of those listed were typical of the heathy sward. Nor is the above list of Fungi by any means exhaustive, there having been present several fleshy saprophytic forms that I had no opportunity to identify or preserve. The soil was almost everywhere dark brown and humous to a depth of 3 to 10 cm., but, being admixed with calcareous particles that effervesced violently with HCl even in the cold, was in reaction neutral to slightly basic (pH 7·2). A herb-rich facies of this heath is seen in Plate XCIX, taken outside the area listed, and with the *Dryas* overtopped by a great abundance of *Carex rupestris*, etc. A large flowering plant of *Oxytropis maydelliana* occupies the centre of the field, and on the left are seen some leaves of *Salix reticulata*.

PLATE XCIX

Herb-rich area of dry heath showing very abundant *Carex rupestris* overtopping the *Dryas* mat, a large caespite of *Oxytropis maydelliana* in flower, and (on left) some leaves of *Salix reticulata*. Coral Harbour, Southampton Island, Aug. 25, 1934.

These rather poor mixed heaths cover considerable tracts of country, but the more luxuriant heathy areas (especially those dominated by *Cassiope tetragona*) appear most often to be developed in situations having an unusually good protective covering of snow in winter, and will, accordingly, be considered under (iv). The more generally favourable areas inland, which probably represent the regional preclimax or possibly even an approximation to the climax, are predominantly grassy-sedgy. They have unfortunately not been investigated in detail, but appear to approximate in floristic composition to a rather dry type of marsh, having much the same dominants as the damper, marshy tundra listed below, although growth is in general far more luxuriant. Viewed from the vantage point of a ridge or hill these areas, and indeed most of the plains inland, look soft and velvety, of a yellowish brown colour tinged in places with green, and dotted with numerous, generally small and shallow lakes. That the vegetation is continuous and luxuriant is seen in Plate C of such an area, although just here the surface is of "giant polygons" whose intervening depressions support bushy willows (often *S. alaxensis*),

and is moreover invested with "hillock tundra" tussocks. These polygons averaged about 15 m. in diameter and appeared to be composed predominantly of dark humus—i.e., "muck" of the type seen on Devon and Akpatok Islands (*See* above, and cf. Leffingwell 1915, p. 653). They supported a swarded or tussocky community of dwarf Salices and other ground-shrubs (including *Dryas*), grasses, and sedges—all being much mixed and variable from place to place, and bound by mosses that very occasionally included Sphagna. On limestone terrain the vegetation is largely different (*See* above).

PLATE C

Giant "tundra polygons" of vegetable "muck" clothed by a grassy-sedgy sward with included ground-shrubs. The polygons average 15 m. in diameter and their intervening depressions support bushy Salices. Inland of Coral Harbour, Southampton Island, Aug. 22, 1936.

(iii) MARSHES

These occupy much of the area of the plains, being sometimes continuous over large tracts of country, whether it be of gneissic or limestone substratum, though usually they are liable to interruption by occasional rocky ridges or slightly drier areas that can still be described as "marshy". Such areas when lying inland tend to be vegetated by a luxuriant grassy-sedgy sward, as has been mentioned above; the following example of "marshy tundra", listed near the sea, probably has a similar floristic composition although the growth of most of the plants is very much poorer:

VASCULARES	*Carex* cf. *aquatilis* var. *stans* x *bigelowii*	vad
	Salix cf. *calcicola* x *richardsoni* var. *mckeandii*	f-lad
	Arctagrostis latifolia	a
	Hierochloe pauciflora	o-a
	Salix arctica	o-a
	Alopecurus alpinus	la
	Carex membranacea	la

Eriophorum angustifolium	la	
Salix reticulata	la	
Dupontia fisheri	f	
Equisetum variegatum	f	
Poa arctica	f	
Dryas integrifolia f. *intermedia*	l	on raised tussocks
Vaccinium uliginosum var. *alpinum*	l	on raised tussocks
Equisetum arvense	o	
Luzula nivalis	o	
Lychnis apetala	o	
Pedicularis sudetica	o	
Saxifraga hirculus	o	
S. stellaris var. *comosa*	o	
Carex atrofusca	r-o	
Arctostaphylos rubra	r	on raised tussocks
Cardamine pratensis var. *angustifolia*	r	(vegetative only)
Carex bigelowii	r	
C. misandra	r	on raised tussocks
Draba fladnizensis s.l.	r	
D. glabella	r	
Eriophorum callitrix	r	
Juncus albescens	r	
J. biglumis	r	in peaty depressions
Polygonum viviparum	r	
Cerastium alpinum	vr	
Eutrema edwardsii	vr	
Carex rariflora	(1 colony)	
Ranunculus pedatifidus var. *leiocarpus*	(1)	

Various other associates and even dominants occur in other places,[1] the composition varying from spot to spot. In this instance the chief *Salix* formed bushes up to 30 cm. high and spreading laterally to attain a diameter of as much as $1\frac{1}{2}$ m., although no proper scrub was formed. Some of the grasses and sedges may even exceed 30 cm. in height, especially in other areas farther inland, although here again there does not appear to be a scrub of Salices of any extent, but rather domination by the grasses and sedges (cf. Plate C).

In the area listed the surface was somewhat hummocky. The larger hummocks, although scarcely entitling the area to be styled "hillock tundra", yet introduced a drier, heathy facies including several lichens. Between some of the tussocks lay dark boggy depressions. Elsewhere, mosses covered the surface between the dominant vascular plants, which alone among themselves occupied almost the whole area. The composition of this moss investment varied from place to place, but *Drepanocladus badius* appeared to predominate more than any other species. Several parasitic and saprophytic Fungi occurred, although the latter were unfortunately not determined. Below the vegetable covering lay about 10 cm. of dark and wet humous soil including mineral grits, some of which effervesced with HCl. Beneath this the substratum was variable. The reaction was about neutral.[2] The following were the most evident or important mosses, lichens, and parasitic Fungi in the area listed:

Musci[3]
Abietinella abietina
Blindia acuta
Distichium capillaceum
Ditrichum lineare
Drepanocladus badius
Meesea triquetra
Tomenthypnum nitens

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[1] Thus *Carex holostoma*, *C. saxatilis*, and *C. vaginata* all grew just outside the area listed, in a tract where bushy Salices were entirely lacking.

[2] Even in other, darker areas, which in my notebooks I called "bogs", and which supported Junci and occasionally some *Sphagnum* sp. or spp., I have failed to find any distinctly acid reaction on Southampton Island, although doubtless such occurs on those gneissic areas that have less admixed calcareous matter.

[3] Only the chief species are listed.

LICHENES[1]	*Cetraria crispa*
	C. nivalis
	Cladonia uncialis
	Ochrolechia sp.
	Peltigera leucophlebia
	Stereocaulon alpinum
	Thamnolia vermicularis
FUNGI[1]	*Claviceps purpurea* on *Arctagrostis latifolia*
	Pseudopeziza drabae on *Draba fladnizensis*
	Puccinia ustalis var. *pulsatillae* on *Ranunculus pedatifidus* var. *leiocarpus*

The more swampy lakeside marshes of the type seen in Plate CII are usually less mixed, being more overwhelmingly dominated by, generally, *Eriophorum angustifolium, Carex aquatilis,* and *Arctagrostis latifolia.* Lake marginal communities will be described as usual under the heading of "Freshwater" (*See* v, below).

(iv) SNOW EFFECT

Owing to the general flatness of the country, the snow does not drift so drastically and deeply around Coral Harbour as it is apt to do in most other parts of our area. There are, accordingly, very few drifts that melt so late that the growing-season about their centres is reduced by more than a few weeks, and, except on the higher hills inland and at the foot of the ridge near the airfield (*See* Polunin MS.o), no extensive patches have been seen as late as August. Even if the usual zoned series of subclimaxes was not widely recognizable, there are two types of community around Coral Harbour that appear to be developed only in relation to drifted and rather late-melting snow.

The first is developed on the bouldery sides of occasional morainic ridges that are higher than the usual rocky ones, the best example that I have seen being the side of the limestone plateau a few miles inland of the Hudson's Bay Company's trading post. Here a great drift of snow collects each winter and melts only relatively late in the summer, so that the growing-season is too short for the usual dominants, and all except the most rapidly vegetating and maturing colonists are to be seen still in flower as late as the end of August. These include *Antennaria angustata, Astragalus alpinus, Cardamine bellidifolia, Cassiope tetragona, Cerastium alpinum, Draba fladnizensis* s.l., *D. crassifolia?* (*See* Part I, p. 239, and cf. Polunin 1938a, p. 100, MS.o, and MS.p), *Eutrema edwardsii, Oxyria digyna, Oxytropis maydelliana, Papaver radicatum, Pedicularis capitata, P. lanata, Poa alpina, Saxifraga cernua, S. tricuspidata, Stellaria longipes,* and *Trisetum spicatum* var. *maidenii.* In a few places where the snow had lasted longest of all, even *Salix herbacea* and *Saxifraga oppositifolia* were still in flower at the end of August in 1936 (as they were in a similar area farther west that I visited toward the end of August in 1946); on the other hand, the earlier melting areas surrounding these latest patches were vegetated by dark *Cassiope* heath.

This last constitutes the second and much more characteristic and frequently encountered "late-snow" community of the district. It is distinguished from the ordinary mixed heath, which covers considerable areas of more or less raised and dry terrain, most obviously by the overwhelming dominance of *Cassiope tetragona.*[2] A 5-metre quadrat in a belt of this, developed in the shelter of a rocky ridge, and passing gradually into the marshy tundra of the ongoing flat, gave the following list; Plate CI shows the end of the patch, where the *Cassiope* occupied only a narrow strip, and was much interrupted by denizens of other habitats:

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[1] See footnote (3) on p. 256.

[2] This is frequently present also in the mixed heath, although such was not the case in the example listed on pp. 252-3, which was of the rather poor type developed in an unsheltered area.

VASCULARES	*Cassiope tetragona*	vad
	Salix reticulata	f-a
	Dryas integrifolia (incl. f. *intermedia*)	la
	Salix herbacea	la
	Carex misandra	f
	C. scirpoidea	f
	Poa arctica	o-f
	Vaccinium uliginosum var. *alpinum*	lf
	Carex bigelowii	o
	Equisetum arvense	o
	Luzula nivalis	o
	Pedicularis hirsuta	o

PLATE CI

Strip of dark *Cassiope* heath in angle between ridge of smoothed gneiss (on right) and ongoing flat of marshy tundra (on left, above). The rock surface is largely covered by crustaceous and foliose lichens, or by mosses (especially *Rhacomitrium lanuginosum*) that precede the heaths. The prostrate *Salix arctica* in the foreground is not very successful in its attempt to extend over the rock without the aid of mosses. Coral Harbour, Southampton Island, Aug. 25, 1934.

	Polygonum viviparum	o
	Oxytropis hudsonica	r-o
	Saxifraga oppositifolia	r-o
	Tofieldia pusilla (T. borealis)	r-o
	Carex nardina var. *hepburnii*	r
	Chrysanthemum integrifolium	r
	Epilobium latifolium	r
	Arctostaphylos rubra	vr
	Draba fladnizensis f. *glabrata*	vr
	Lychnis apetala ?	vr
	Lycopodium selago	vr
	Draba glabella	(1)
	Eutrema edwardsii	(1)
	Pedicularis lanata	(1)
	Ranunculus pedatifidus var. *leiocarpus*	(1)
	Rhododendron lapponicum	(1)
BRYOPHYTA	*Abietinella abietina*	
	Aulacomnium palustre	
	*Chandonanthus setiformis**	
	Dicranum groenlandicum	
	Distichium capillaceum	
	Gymnomitrium sp.*	
	Kiaeria blyttii	
	Preissia quadrata	
	Rhacomitrium lanuginosum	
LICHENES	*Cetraria crispa*	
	C. cucullata	
	C. delisei	
	C. nivalis	
	Dactylina ramulosa	
	Lecanora epibryon	
	Lecidea wulfenii	
	Ochrolechia frigida	
	Peltigera sp.	
	Stereocaulon alpinum	

These mixed cryptogams were "fillers" rather than evident associates, as the dominant covered about three-quarters of the area and the spaces between its tussocks were almost entirely occupied by other phanerogams. Although the lists of cryptogams do not pretend to be exhaustive, they probably mention all species that had any importance or ecological significance in the quadrat—including the chief colonists of the occasional bare patches and projecting stones. Remarkable was the absence of Cladoniae; in fact "reindeer moss" swards of lichens are rather rare and of poor development in this district and, according to Messrs. P. D. Baird and T. H. Manning, in the whole of Southampton Island. This does not necessarily mean that the island is unsuitable for domesticated reindeer; indeed, considering the abundance of luxuriant marshes, it is possible that the lack of shelter and tight packing of the snow in winter might prove the chief or only deterrents to their successful introduction, now that the herds of wild caribou are so drastically reduced[1] and the roaming of the sledge-dogs is curbed in summer. Good summer feed is present in virtually unlimited quantity in the sedgy-grassy plains, and hardy reindeer as is well known can become acclimatized to eat such plants in winter when they are made easily available, even if an abundance of their favourite "moss"[2] is normally required for their successful maintenance in large numbers (cf. Porsild 1929, p. 40, and 1937, p. 133).

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* Field-note report omitted from Part II of the present series.

[1] In 1946 I was informed that with proper protection the numbers had latterly started to increase again substantially.

[2] The popular belief that they cannot exist without "reindeer moss" (Cladoniae, etc.) is only surpassed in ludicrousness by the statement made to the Royal Commission in Ottawa (Anon. 1922, p. 90) that "sphagnum moss....is their sole food. Unless they get this they die."

The *Cassiope* in the above heath grew 10 to 12 cm. high, was fruiting abundantly, and in places formed an almost continuous dark sward. The chief cryptogams were the *Dicranum* among the bryophytes and Cetrariae among the lichens—except for *C. nivalis,* which was little in evidence here where the snow-covering was good and long lasting. The soil was dark brown and humous to a depth of 5 to 10 cm. The pH where measured was 7·2, although none of the grits or silt that I tested would effervesce at all with HCl in the cold.

(V) FRESHWATER

By the time of my visits to Coral Harbour, which have all been in late August, most of the small streams had more or less dried up, although a few still carried a trickle of water. Such trickles and puddles frequently supported green wefts or a yellowish scum of filamentous Algae—generally sterile *Zygnema* spp. Like some of the more open, peaty depressions in marshes, the beds of these streams, where they were lastingly damp and of moss or mud, supported such (generally "open soil" and diminutive) colonists as:

Arenaria rossii var. *daethiana*
A. uliginosa
Braya sp.[1]
Cardamine pratensis var. *angustifolia*
Carex atrofusca
C. bicolor
Chrysanthemum integrifolium
Epilobium davuricum var. *arcticum*
Equisetum arvense
E. variegatum
Eutrema edwardsii
Juncus biglumis
Lychnis apetala
Ranunculus hyperboreus
Saxifraga nivalis var. *tenuis*
S. oppositifolia
S. rivularis

The cryptogamic communities of lakes were not investigated in detail, but it was noted that deposits on mud were, as elsewhere in our area, rich in desmids and other diminutive Algae—including in one instance much sterile *Zygnema* sp. in which were scattered the hitherto undescribed *Closteriopsis brevicula,* and also *Cosmarium subarctoum, Staurastrum muticum,* and *S. proboscidium.* Luxuriant, dark brown beds of aquatic mosses covered the bottoms of many lakes, at least near their margins. In one instance where the water was shallow (1-3 feet) the species concerned were *Drepanocladus revolvens, D. sendtneri,* and *Scorpidium scorpioides.* A brownish green, slimy deposit, taken on August 22, 1936, from the bottom of this lake near its margin, contained the following freshwater Diatomeae:

Achnanthes flexella
A. minutissima var. *cryptocephala*
Amphora ovalis var. *pediculus*
Caloneis silicula var. *alpina*
Cyclotella antiqua
Cymbella angustata var. *hybrida* and var. *linearis*
C. botellus
C. cesatii
C. cistula var. *eucistula*
C. microcephala

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[1] Cf. footnote (1) on p. 253.

C. scotica var. *incerta*
C. subaequalis var. *oblonga*
C. turgidula
C. ventricosa var. *genuina*
Denticula tenuis var. *intermedia*
Diatoma tenue var. *pachycephalum*
Diploneis oblongella var. *oblongella*
Eunotia curvata
Fragilaria pinnata
Gomphonema subclavatum
Navicula bacillum
N. minuscula
N. variabilis var. *gomphonemacea*
N. vulpina
Neidium iridis var. *majus*
Nitzschia amphibia
N. angustata
N. frustulum
N. palea
Pinnularia fasciata var. *inconstantissima*
Synedra amphicephala
S. ulna var. *genuina*
Tabellaria fenestrata

Plate CII illustrates how, where a lake's margin is of rock, phanerogamic colonists are usually absent, but where it is of shelving mud or gravel there may be beds of semi-aquatics extending out into the water. The plants that do this most actively are *Carex aquatilis, Colpodium fulvum* var. *effusum, Eriophorum angustifolium,* and *Hippuris vulgaris,* and any of these may form luxuriant beds quite locally, at least where the water is not more than 30 cm. deep. Behind stretch luxuriant marshes (seen in the foreground in Plate CII) dominated by the

Plate CII

Luxuriant lakeside marsh dominated by ***Eriophorum angustifolium*** and ***Carex aquatilis*** which both extend out into the water. In the background the lake margin is of rock and, consequently, is largely barren. Coral Harbour, Southampton Island, Aug. 25, 1934.

Eriophorum and *Carex* (both of which may attain a height of 50 cm.), with associated Salices, *Carex membranacea, C. physocarpa,* and such tall and coarse grasses as *Arctagrostis latifolia*[1] and *Dupontia fisheri.*

In some sheltered situations inland, where the water level is not subject to undue fluctuations in late summer, and where waves do not beat too hard, muddy lake margins frequently support a zone of *Carex chordorrhiza* nearest the water.

(vi) SEASHORE

There has unfortunately not been an opportunity during my various brief visits to Coral Harbour to investigate the marine communities, although to judge from the appearance of such Algae as *Alaria esculenta* and *Desmarestia aculeata,* which are to be found cast up on the shore in a fresh condition even in the sheltered bay, the marine vegetation is plentiful enough (cf. p. 245). The inter-tidal banks in most places slant only slightly and consist of rounded boulders of all sizes embedded in clayey gravel, which is light grey and composed largely of limestone material. Here vegetation is plentiful. *Fucus vesiculosus* is abundant almost everywhere that it can get a stipe-hold, and various associated smaller Algae occur—including species of *Cladophora,*[2] *Enteromorpha,*[2] and *Ulothrix*[2] even near high water-mark.

The shores above are in most places of rocks or boulders that are devoid of higher plants where reached by waves, but behind soon come to support ordinary land vegetation. However, in places small areas of mud or sand are found, which may support the usual community of such situations, viz., a tangled mat of reddish *Puccinellia phryganodes,* with associated *P. paupercula, Stellaria crassifolia, S. humifusa, Cochlearia officinalis* var. *arctica* and var. *groenlandica, Matricaria inodora* var. *nana, Carex bipartita* var. *amphigena, C. salina* and its var. *subspathacea,* and probably also *C. ursina.*[3] In other places there may be a shingly beach, colonized by *Elymus arenarius* var. *villosus* and *Arenaria peploides* var. *diffusa,* and, in sandy places higher up, by a host of "open soil" and other plants from the raised land areas behind. The most abundant of these denizens are Drabae and grasses—especially *Alopecurus alpinus, Festuca brachyphylla,* and *Poa glauca*—which persist with increased luxuriance in the areas of Eskimo encampment.

(10) WEST COAST OF HUDSON BAY

This last of our phytogeographical subdivisions comprises the Hudson Bay and Roes Welcome coast of Keewatin and its adjacent small islands. Localities that lie more than a few tens of miles west of the general seacoast are usually ignored in the present volume as in Parts I and II, even though some extension seems desirable for the future (cf. Polunin MS.o). The area is, consequently, rather small, although the "district" extends from 60 degrees northwards to the Arctic Circle (66° 32′ N.), and from 85° 51′ W. to 95° W.

Although it may be quite hilly in places, the whole region is occupied by comparatively low country (not exceeding 1,200 feet) belonging to the "coastal plains" (rather than the main Canadian Shield), most of which have emerged from the sea only in relatively recent times (cf. Blanchet 1930, pp. 5 *et seq.*).

[1] Frequently appearing proliferous as a result of infection by *Claviceps purpurea.* The same appears to happen, much more rarely, to the *Dupontia,* but it is possible that a different parasite is involved in this case.

[2] Cf. footnote (1) on page 29.

[3] At the time of writing I had not seen this species growing on Southampton Island, but it had previously been found there (cf. Polunin 1938a, p. 96), and is practically confined to this habitat, in which I saw it flourishing elsewhere in South Bay in 1946.

The outer coast is straighter than many in our area, but there are various bays and narrower inlets, sometimes of great length. In the extreme north, around the south coast of Repulse Bay, the hills rise to about 1,000 feet (305 m.)[1]; but like all others in this region they have been more or less smoothed by glacial action. The hills to the south (i.e., when the country is not quite flat) are generally lower and gently rounded; the coasts, though low-lying, are in most places rocky and broken, and accompanied by numerous islands and reefs (cf. Tyrrell 1897, pp. 79F *et seq.*, and Smith 1932, pp. 65-70). However, south of Eskimo Point (Cape Eskimo) there are very few islands, the coast here being of sand or shingle and almost straight. It is extremely low, as is also the hinterland. For further details of these coasts and the lake-bound and river-dissected "barrens" behind, reference may be made to the account given by Birket-Smith (cf. 1933).

GEOLOGY

On this a few general words will suffice, in view of the useful accounts already given by Bell (cf. 1885), Tyrrell (cf. 1897)[2], and Birket-Smith (1933, pp. 35 *et seq.*). Broadly speaking, the northern half of the coast and accompanying hinterland is occupied by a single series of granites and gneisses, presumably of Precambrian age, whereas the bedrock in the southern half is more variable, being of similar granites and gneisses in some places but of other Archæan rocks, chiefly Huronian quartzites and schistose diabases or gabbros, around Rankin Inlet (c. 62° 42′ N.; c. 92° W.) and again in the region of Mistake Bay (cf. Alcock 1937, map on p. 147). It is a peculiar whitish quartzite that is commemorated in the name of Marble Island, lying just off Rankin Inlet. However, many areas, especially where the land is low and flat, as is frequently the case, are covered with rewashed-morainic material and other post-glacial deposits, including much alluvium; indeed in the extreme south there is hardly any bedrock to be seen *in situ*. Elsewhere the country tends to be rather more hilly, although the whole shows flagrant evidence of having been intensely glaciated.

CLIMATE

Although the climate tends on the whole to become harder to the north and more favourable to the south, the following observations from Chesterfield, which is situated very near the centre of this last major district, will serve as an indication of the sort of weather to be expected in most parts of it, and will also show how 'continental' in type is the climate in spite of the coastal position. This is to a large extent dependent upon the northwesterly direction of the prevailing winds. Thus at Chesterfield, greater extremes are encountered than at any other place in our area from which reliable data are available, the winter being bitterly cold (temperatures of −60° F. have been recorded) and the summer sometimes quite hot (temperatures over 80° F. are not infrequent). The precipitation, too, is temporarily concentrated; generally it totals about 11 inches (28 cm.) in the year and is more than half in the form of rain, which falls during the 4 months July to October. Although July and August are usually without frosts, these can occur at any time in bad years.

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[1] These taller hills are toward the western end of the bay, those nearer the Roes Welcome coast, around Beach Point, being much lower (cf. Birket-Smith 1933, p. 94).

[2] *See also* the French translation "Rapport sur les rivières......et la côte nord-ouest de la baie d'Hudson"; *Commiss. Géol., Canada, Rapp. ann. N. sér.*, Tome IX, Ottawa, 1898.

Chesterfield, 63° 20′ N., 90° 42′ W. Average 1933-6.

Month	Temperature °F.			Precipitation	
	Maximum	Minimum	Monthly mean	Total inches	Snow or rain
January	5·5	−51	−26	0·05	S
February	4	−44·5	−25	0·42	S
March[1]	15[1]	−42[1]	−16[1]	0·75[1]	S
April	27·5	−28	1	0·65	S
May	37	−10	19	0·46	"S"
June	63	19	36·5	0·66	R
July	77	33	48·6	1·82	R
August	65·5	34	47	1·79	R
September	57	22	36·5	1·94	S and R
October	37	−11·5	16	1·12	S and a little R
November	22	−30	− 2	0·64[1]	S
December	9	−45·5	−21	0·57	S

[1] Average of only 3 years.

Inland, to the west, the climate may be still more severe; but, even if it has been held that here in places some considerable treeless areas are to be classed as steppes rather than arctic tundra, on account of the dry conditions being the cause of the stunted growth, there can be little doubt that the temperature relationships and exposure at Chesterfield are alone sufficient to prevent tree growth,[1] and that this region belongs to the arctic tundra zone proper. The same is probably true of the rest of the area comprising our district 10, even if trees occur outside it at similar latitudes inland, and not so far to the south reach the exposed Hudson Bay coast.

VEGETATION

The only attempted account, of any considerable length, of the vegetation of this district is that of Birket-Smith (1933, pp. 77-83); although headed "Biogeography. Vegetation", and containing some useful notes on the general conditions, it is lacking in precise details and is, consequently, disappointing from our present point of view. I will, accordingly, select from the general literature and personal observations such notes and citations as seem most pertinent for a brief "running" survey of the coast from north to south. In the most general sense the vegetation, like the flora, increases in luxuriance as the climate ameliorates along this line; this has already been pointed out by Macoun (1911, p. 281), although his contention that there are no arctic plants to the south, at Churchill, is now known to be unjustified (*See* Part IV of the present series).

The northernmost section of the coast, i.e., Roes Welcome south of Repulse Bay, is little known vegetationally although reputedly barren. However, to judge by its fame among the local Eskimos as a region for caribou in summer (cf. Birket-Smith 1933, pp. 94 *et seq.*), its flat and monotonous hinterland must support considerable tracts of (probably closed) marshy vegetation. Nevertheless the flora is an arctic one—a condition that holds good past Wager Bay (Macoun 1911, p. 281) and Whale Point (cf. Fernald 1899). South and west of Cape Fullerton,[2] however, the vegetation would appear to make rather more of a "show", for hereabouts Rae (1850, p. 182) speaks of the country "for a mile or

[1] Thus J. B. Tyrrell, who probably knew these "barren lands" better than any other scientist, affirmed (1897, p. 164F) that their "surface in summer is almost constantly wet".

[2] Already north of this point Rae (1850, p. 30) speaks of finding "some willows fully an inch in diameter", and, later (p. 31), others that were even larger.

two inland" as of "rocks, clothed in some spots with moss or grass". Most of the specimens that I have seen from around Fullerton are better grown than from places to the north. Of Winchester Inlet, near here, Smith (1932, p. 67) quotes a good account, which shows that the country has indeed "all the physical characteristics common to similar areas in the south". It is "underlain by Archæan crystalline rocks.... Long, gentle rounded hills, of slight elevation, form the higher grounds, with wide, shallow valleys between them. The whole has been intensely glaciated, and the abrasion of the great ice-cap has reduced the general surface to as near a level surface as possible, considering the varying resisting properties of the different rocks found here. There is no soil upon the rocky hills, while that of the valleys is largely boulder clay in which the coarser material predominates, leaving little room for the growth of Arctic vegetation upon the finer materials of the soil. Boulders scattered in profusion over the rocky hills give to the latter a peculiarly ragged appearance. Lakes and ponds dot the valleys, and much of the land surrounding these is low and swampy".

Similar conditions prevail around the mouth of Chesterfield Inlet, where the flora includes certain "southern" elements (*See* Gardner 1937, and cf. Part I of the present series). At Chesterfield post I have made a survey of the main plant communities. These will be described in detail below, so it seems unnecessary here to deal in a general way with this region, the more so as it appears to be unusually "uniform" from place to place, even if farther inland it may be relatively barren (cf. Tyrrell 1897, p. 80F, and cf. Pl. VI).

Inland of Winchester Inlet, to the north of Chesterfield, the land from the air again appears monotonous and rather dark, with frequent small lakes that help to make the terrain look like the gneissic parts of Southampton Island, though often it appeared more rocky and barren as regards higher vegetation, with lakes more numerous and yellowish lichens more noticeable. Still farther inland toward the eastern end of Baker Lake, however, the vegetation looks more luxuriant, with extensive marshes in the valleys and more browns showing about the grey and scoured hog's-back hills, whose rounded tops alone in places showed through the soft and usually heathy covering of changing browns and yellowish browns.

South of Baker Foreland, which separates Chesterfield Inlet from Rankin Inlet, lies (quartzite) Marble Island, which has been described by Bell (cf. 1887). Of this island the shores look glaring white, "the rocks being free from lichens, &c., and the hills in the interior, which are rounded, are also pure white, and contrast strongly with the dark brown of the peaty flats and hollows" (Bell 1884, p. 35DD). Rankin Inlet, to the west, has "behind the beach....low grassy hills, with bosses of rock projecting here and there through the turf" (Tyrrell 1897, p. 82F). Although relatively barren rocky hills and sand banks persist in many places, conditions and the vegetation on the whole improve as we go farther south, to judge from the accounts of this last (generally quite reliable) author. Thus dwarf birches (*Betula glandulosa*) are plentiful around 62°N., whereas a little south of Wallace River, in about 61° 40′ N., "the tide runs out for a couple of miles, leaving behind it a wide sandy flat, studded with boulders, and partly covered with ropy seaweeds. Behind the beach is a wide grassy flat, dotted with small lakes, which extends back a couple of miles" (Tyrrell 1897, p. 86F). Again, "For several miles south of McConnell River,[1] a level well-grassed sandy plain extends along the shore" (*ibid.*, p. 87F).

[1] 60° 50′ N. at its mouth. (N.P.)

In spite of this general amelioration of conditions and the vegetation to the south, there are some places, especially around Eskimo Point (where barren eskers relieve the flat monotony of the coast) and in the extreme south of our area, where the low shores are said to be largely of limestone shingle and practically barren (cf. Bell 1885, p. 19DD). Only about Little Seal River, to the south of our southern boundary, do large bushy willows begin to appear on the coast, although even at these low latitudes there may be hills "covered with black lichen"[1] (cf. Tyrrell 1897, pp. 90F and 142F).

The occurrence of *Zostera marina*,[2] sometimes in great abundance, on the west coast of Hudson Bay has been known at least since the time of Rae (1850, p. 193). Its northernmost known locality in these regions is Eskimo Point (*See* Porsild 1932, pp. 91-4, and cf. part I, p. 40); as it here chiefly, perhaps entirely, persists in the vegetative condition, it is unlikely that it occurs much farther north on this coast. Even if at Eskimo Point it appears to be eking out a rather precarious existence, its beds here around low tide-mark are very extensive, according to verbal information from Mr. T. C. Carmichael of the Hudson's Bay Company, and must be recounted as being ecologically important as well as noteworthy. Otherwise, except for some notes from Chesterfield, which will be given below, little can yet be said about the marine vegetation of these regions, although the existence in many places in the north of Hudson Bay of extensive beds of laminarians and other Algae is well known. It appears that this west coast of Hudson Bay would prove a particularly worthwhile (and, perhaps, fertile) region for phycological and other surveys, and probably still for general floristic ones; nor is it as difficult of access as most of the other lesser known parts of the Canadian Eastern Arctic.

To the west, on Christopher Island, which lies around latitude 64° 2′ N. and longitude 94° 30′ W., near the eastern end of Baker Lake, and is hence outside the area considered in the present volume, I made intensive observations in 1946. The island is of tortuous outline and rather hilly. It is built of acid-weathering rocks, but bears large beds of marine shells that introduce a considerable calcareous element at the lower levels. Although extensive scrub is absent, the vegetation is almost continuous in favourable areas. The flora, too, is very considerable, and includes several angiosperms that are unknown to the east—at least so far north in Canada. The vegetation survey involved the following main categories: damp mossy heath, dry lichen-rich heath, mixed willow-birch scrub, sandy, etc., lake-side slopes, marshes and lake-side flats, hill-top rocks and boulders, tarns and their marginal communities. In spite of the fresh-looking shells and other indications that the smooth lowland plains had risen out of the sea only in comparatively recent times, the soil development was fair. However, little humous accumulation was observed and the soil-water reaction was usually near neutrality. The highest type of vegetation was the loose willow-birch scrub up to 2 feet high that was developed on some of the most favourable sandy or bouldery slopes and supported a fair ground-shrub layer beneath the dominants.

Flying from Christopher Island south to Churchill early in September, 1946, I noted that for 100 miles and more the monotonous terrain and dwarfish vegetation appeared much the same as on Christopher Island, though tarns were more numerous and some lakes and streams of fair size were observed.

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[1] Reported by Tyrrell (*l.c.*) as *Alectoria divergens*, which is now referred to the genus *Cornicularia* as *C. divergens* Ach.—*See* Part II, p. 355.

[2] Mr. A. J. Wilmott's interesting suggestion (1942, p. 7) that the Hudson Bay plants may belong to the recently described "more boreal *Z. Hornemanniana* Tutin" needs looking into.

Thus, water usually occupied at least one-quarter of the area, another one-sixth or so being of rather barren-looking, dark grey hills or bouldery slopes, and the remainder of brownish or sometimes yellowish vegetation. The lake shores appeared shelving, but the waters fairly deep farther out. Usually the margins were boulder-strewn, with boulders sticking out of the water; sandy beaches were fewer and usually of small extent. Giant or other polygons or solifluction streaks were often well marked, the latter sometimes extending quite deep into the lakes. Farther south near the shores of Hudson Bay the rocky prominences of the north gave way to flattish plains, but although the vegetation appeared green and more nearly continuous, from the air only occasional patches of taller scrub were visible in the most favourable situations—particularly along streams. Nothing approaching tree growth was to be seen north of the 60th parallel (cf. Halliday 1937); nor could I see any 'bush' spruce (Halliday and Brown 1943, map on p. 358) near the coast.

Plant Communities Around Chesterfield

Chesterfield post (Spurell Harbour) lies in latitude 63° 20′ N., longitude 90° 42′ W., on the south side of the entrance to Chesterfield Inlet, through which ocean-going ships can pass for a great distance from the sea and Hudson Bay.[1] Its population is given by Bethune (1935, p. 163) as only 11 Whites, 82 Eskimos, and 1 Indian. Nevertheless it is an important centre, for here are the regional headquarters of the Royal Canadian Mounted Police and of the Hudson's Bay Company, as well as of the medical health officer for Keewatin and the Roman Catholic Mission and hospital. There has also been here for more than a decade a Radio and Meteorological station. An aircraft landing strip was added in 1946, when materials were also brought in for the establishment of a scientific station.

The country around Chesterfield is rocky but flat and exceedingly monotonous (Plate CIII), with only a very poor plant "covering" except in sheltered depressions. Indeed plant life on the whole is considerably less prolific than at Coral Harbour, Southampton Island (*See* above). The fundamental rocks are grey gneisses of various types, rendered more or less reddish brown by contained iron salts. The surface has been smoothed by glacial or submarine action and is in places littered with rounded boulders. The valley depressions, which alone are at all well vegetated, are lined with rewashed glacial material that is usually rather shallow and contains little, if any, limestone and generally few shells. The hills are low and rolling and largely devoid of soil and, consequently, of higher vegetation. Most of them have rather the form of ill-defined, rocky ridges, and few, if any, in the vicinity exceed 200 feet (61 m.) in height. Although intersected by numerous narrow ravines and lakes, these ridges project sufficiently to give to the country a desolate, rock-bound appearance, whose grey and ragged stoniness is further accentuated in some places by an abundance of rounded erratic boulders. A striking character is the general lack of comminuted soil, less than one-sixth of the area, according to my computation, being occupied by substrata that are suitable for the roots of vascular plants.

The climate, which for a coastal station is surprisingly "continental" in type, has been described above (*See* pp. 263-4).

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[1] Chesterfield Inlet is about 120 miles long and is continued for another 60 miles or so by Baker Lake, which is a total of about 1,000 miles from the entrance of Hudson Strait. Tidal water reaches Baker Lake and this is said to involve "the farthest distance to which salt water penetrates any continent with the exception of the Mediterranean region."

PLATE CIII

General view of typical, rocky but flat country with little higher vegetation except in sheltered depressions. Chesterfield, W. Coast of Hudson Bay, Aug. 19, 1936.

(i) RAISED RIDGES

As has already been mentioned, these are comparatively low, rocky, and barren, there being no prominences in the vicinity that deserve the designation of hills except in the most limited and localized sense. The tops of such ridges are typically of smoothed gneiss that is about half covered with dark Gyrophorae and other foliose and crustaceous lichens—especially species of *Lecanora, Lecidea, Parmelia,* and *Rhizocarpon.* In crevices and slight depressions where they can get a hold, mossy mats (generally of *Rhacomitrium lanuginosum*) occur, in which quite numerous phanerogams may root. These may include almost any of the hardier xerophytes of the heathy and other areas developed below, although *Hierochloe alpina* and *Luzula confusa* are the most typical (almost constant) members. The following were the phanerogams and chief cryptogams of one 5-metre quadrat:

SPERMATOPHYTA	*Hierochloe alpina*	f-lvad
	Luzula confusa	f
	Festuca brachyphylla	r-o
	Silene acaulis var. *exscapa*	r
	Empetrum nigrum var. *hermaphroditum*	vr
	Poa arctica	(1)
	Saxifraga tricuspidata	(1)
MUSCI[1]	*Rhacomitrium lanuginosum*	va
	Pohlia drummondii	
	Drepanocladus uncinatus	l
LICHENES[1]	*Alectoria cincinnata* var. *vexillifera*	
	Buellia atrata	
	Caloplaca sorediata	
	Cetraria delisei[2]	

[1] Only the most important species are listed.

[2] The record of this species from Chesterfield was inadvertently omitted from Part II, p. 351.

Gyrophora cylindrica var. *delisei*
and var. *fimbriata*
G. hyperborea
G. proboscidea
Haematomma ventosum var. *lapponicum*
Lecanora bicincta
Lecidea spp.
Parmelia alpicola
P. centrifuga
P. saxatilis
Physcia pulverulenta ?
Rhizocarpon eupetraeum
R. geographicum
Umbilicaria lyngei

The abundance of the *Rhacomitrium* and *Hierochloe* made the area look straw coloured from a distance, although such "higher" vegetation covered only about one-fifth of the area. In the absence of mineral "soil", except for a few splinters and grits that gravitational and other forces had thrown together in depressions and crannies, the phanerogams were practically confined to the more luxuriant areas of moss, whose closely moulded and woven mats came away cleanly from the rock, there being no humous accumulation of any extent. The cryptogams were many and variable, and grew best in the shelter of boulders or prominences in the rocks; indeed mosses other than the *Rhacomitrium* were largely confined to such more favourable microhabitats.

PLATE CIV

Old, crumbling, rocky surface largely covered with lichens of good growth, with *Empetrum* (below) and *Potentilla vahliana* (flowering, above) rooting in crevices. Chesterfield, W. Coast of Hudson Bay, Aug. 19, 1936.

In places where the rock was smooth and unbroken, there were often no higher plants at all over areas many metres in diameter; conversely where the surface had begun to crumble there were numerous plants, including such "heaths" as, particularly, *Empetrum nigrum* var. *hermaphroditum*. Plate CIV

shows a little of the *Empetrum* (below) and *Potentilla vahliana* (in flower, above), both having attained ecesis apparently without the aid of a moss mat in crevices of an "old" broken rocky surface that is elsewhere largely covered with lichens of good growth. Plate CV shows a large, tangled plant of *Saxifraga tricuspidata* in flower on a frost-shattered, rocky surface whose "youth" and attendant instability has precluded extensive lichen growth; in a crevice on the left is seen a poor, thin plant of *Poa glauca,* attenuated in the manner highly characteristic of such habitats.

PLATE CV

"Young", frost-shattered surface of friable rock with little lichen development but with a large "tangle" of *Saxifraga tricuspidata* in flower. In a crevice on the left is an attenuated plant of *Poa glauca.* Chesterfield, W. Coast of Hudson Bay, Aug. 19, 1936.

(ii) GENERAL PLAINS

Apart from the marshy and snow-patch series described below, the plains, if such they may be called, are chiefly occupied by two main types of community, each of which comprises a whole series of variable facies that merge into one another and into the other vegetational types of the district.

I. The first series is of "barrens" and "half-barrens", which altogether cover more of the area—at least according to my rather rapid estimate—than any other type of vegetation. They are, of course, variable in type and composition as well as in luxuriance. The following was the *Vasculares* composition of a 5-metre quadrat in one relatively well vegetated "barren" developed on a rough slope of morainic gravel and boulders that was about one-fifth covered by individual plants or irregular patches of higher vegetation:

Hierochloe alpina	a
Saxifraga tricuspidata	a
Epilobium latifolium	f-la
Festuca brachyphylla	f

Vaccinium vitis-idaea var. *minor*	l
Draba nivalis	o
Dryas integrifolia	o
Luzula confusa	o
Oxytropis bellii	o
Potentilla nivea var. *subquinata*	o
Stellaria longipes	o
Poa arctica	r-o
Dryopteris fragrans	r
Poa glauca	r
Salix arctica	r
Draba glabella[1]	(1)

Cryptogams were numerous and much mixed, but generally of poor growth, the situation being rather exposed. *Rhacomitrium lanuginosum* was the most abundant, and with the *Hierochloe* again rendered the area straw coloured when viewed from afar. All of the lichens listed from the rocky ridge occurred in plenty, and, in addition, several other species of *Alectoria* and *Cetraria*. In the slightest of depressions there were to be found various heathy plants, showing how fickle is the distinction between this and the next main series of communities.

II. These are the closed "heaths" developed on marine deposits or alluvial or comminuted substrata in sheltered situations. They are generally luxuriant and fully closed and consolidated, but much mixed—as is indicated by the following list, taken from a 5-metre quadrat, and giving the phanerogamic[2] constitution of a typical example:

Vaccinium uliginosum var. *alpinum*	a-lvad
Empetrum nigrum var. *hermaphroditum*	f-lvad
Ledum palustre var. *decumbens*	f-lacod
Arctostaphylos alpina	a
Vaccinium vitis-idaea var. *minor*	a
Salix herbacea	f-a
Carex bigelowii	f
Cassiope tetragona	o
Luzula confusa	o
Salix arctica apprg. var. *kophophylla* } *S. hudsonensis* }	r
Hierochloe alpina	r
Oxytropis maydelliana	r
Astragalus alpinus	(1)
Carex capillaris (or possibly *C. williamsii ?)*	(1)

This is a small flora, owing to the overwhelming dominance of the heaths. Cryptogams, however, were numerous and of good growth, including a considerable number of mosses and several hepatics. *Rhacomitrium lanuginosum* was still the most plentiful moss, but the lichens included various large species of *Cetraria* and *Cladonia*, and also *Dactylina arctica, Lobaria linita, Peltigera leucophlebia, Sphaerophorus globosus*[3] (va), and *Stereocaulon alpinum.* An unusual number of saprophytic Fungi, many of them with large fruiting bodies, were noted in this habitat in August, and also the following parasitic species: *Cintractia caricis* on *Carex bigelowii, Exobasidium angustisporum* on *Arctostaphylos alpina, E. vaccinii* var. *myrtilli* on *Cassiope tetragona, E. vaccinii-uliginosi* on *Vaccinium uliginosum* var. *alpinum*, and *Sphaerotheca humuli* on the occasional plants of *Potentilla hyparctica* var. *elatior (P. emarginata).*

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[1] Parasitized by *Puccinia drabae.*

[2] No vascular cryptogams were present in this instance.

[3] The record of this species from Chesterfield was inadvertently omitted from Part II, p. 308.

The heaths, as the list shows, tend to be much mixed, the dominance often varying from place to place. Beneath the consolidated sward, which they and the associated cryptogams form, there may be a few centimetres of humous soil (in the area of the quadrat this layer was 10 cm. deep), although frequently there is so little of this as to suggest emergence from the sea only in quite recent times. Such "heaths" cover altogether considerable areas, chiefly on low-lying flats and slight slopes of marine veneer, although they may also extend over smooth or broken rock surfaces; but they rarely persist for many metres in any one direction without being interrupted by projecting boulders or some other habitat or community. Sometimes there may be associated prostrate *Betula glandulosa* var. *sibirica*, or low but scrubby willows including *S. alaxensis* and, in one instance that I saw, upright 1-metre high bushes of *S. planifolia*. However, these "trees" were all more or less isolated individuals that appeared to be limited to areas that were drifted over deeply with snow in winter, no extensive scrub being encountered in the neighbourhood.

(iii) MARSHES

Marshy areas, at least near the coast, are no exception to the generalization that the vegetation at Chesterfield is less luxuriant than at Coral Harbour and some other places of similar latitude around the shores of Hudson Bay. However, at Chesterfield the marshes are also unusually variable. Reasons for this are not far to seek. The habitats, although the country is everywhere quite low, change drastically from spot to spot, and with such changes (or often without them, the communities being "young" and jumbled, and the vegetation having little real "grip" on the terrain) the vegetation alters in composition and luxuriance. Frequently the marshes are mossy, but still very mixed as regards dominance, the following being the composition of a small area of one such marsh developed near the margin of a tarn:

VASCULARES	*Dupontia fisheri* (incl. var. *aristata*)	a-lvad
	Carex aquatilis apprg. var. *stans*	f-lvad
	Salix arctophila	a
	Hierochloe pauciflora	f-la
	Carex chordorrhiza	o-la
	C. physocarpa } *C. saxatilis* }	o-la
	Potentilla palustris	o-la
	Arctagrostis latifolia (incl. f. *aristata*)	f
	Poa arctica	f
	Saxifraga hirculus var. *propinqua*	f
	Koenigia islandica	vl colonies on mosses
	Carex bipartita	o
	Eriophorum angustifolium	o
	Luzula spadicea	o
	Polygonum viviparum	o
	Salix arctica	o
	Saxifraga cernua	o
	Equisetum arvense	r
	Eriophorum scheuchzeri	r
	Juncus castaneus	r
	Saxifraga stellaris var. *comosa*	r
	Juncus albescens	vr
	Ranunculus pedatifidus var. *leiocarpus*	vr
	Vaccinium uliginosum var. *alpinum*	(1 patch)
MUSCI	*Aulacomnium palustre*	
	A. turgidum	
	Calliergon sarmentosum	
	C. stramineum	

Cinclidium subrotundum
Dicranum laevidens
Drepanocladus revolvens
Meesea triquetra
M. uliginosa
Oncophorus wahlenbergii
Polytrichum juniperinum
Sphagnum squarrosum

FUNGI PARASITICI[1] *Cintractia caricis* on *Carex physocarpa*
Claviceps purpurea on *Dupontia fisheri*
Puccinia ustalis var. *pulsatillae* on *Ranunculus pedatifidus* var. *leiocarpus*
Rhytisma salicinum on *Salix arctophila*

This is a considerable list for a small area of marsh (not much more than a 5-metre quadrat), and indicates that, in spite of the unusual number of rather rank plants that were plentiful and even ecologically important, having frequency degrees ranging up to at least "la", the dominance was far from good. The mosses also were much mixed; but although they included some mesophytic species (such as the *Polytrichum*), there were no mature and identifiable lichens to be found just here. This suggests that the area is not to be considered as "physiologically dry", even if it may be rendered so in appearance in places that are exposed to the prevailing winds, which before reaching this place have swept over so many hundreds of miles of country to the west.

Other noteworthy marsh plants that are locally fairly plentiful around Chesterfield include *Andromeda polifolia, Carex rariflora, Eriophorum chamissonis* f. *albidum, E. spissum, Pedicularis sudetica, Ranunculus lapponicus,* and *Rubus chamaemorus*, all of which are characteristic chiefly of the most luxuriant boggy areas, where Sphagna are usually much in evidence. Even here there is rarely if ever a humous deposit of any real depth; when the feet sink into a "squishy" lakeside swamp they generally meet a hard rock or stony substratum not far down. The mosses are frequently much permeated by lemming runs, but without the vegetation appearing to suffer seriously from the attentions of these animals, even the bulbils of *Polygonum viviparum* and *Saxifraga cernua* being frequently left alone.

(iv) SNOW EFFECT

As in the case of Coral Harbour (*See* above), no very "late-snow" areas were encountered at Chesterfield—nor, having regard to the small snowfall and the local topography and warm summer, are many to be expected.[2] Certainly they are areally insignificant in the district. However, the same is not true of *latish* snow-patches, which indeed occur plentifully in depressions or behind rocky ridges where drifts form so deeply in winter that the growing-season is appreciably, though not drastically, shortened by their late melting in summer. The characteristic community here is a dark heath dominated by *Cassiope tetragona*, a 5-metre quadrat in one somewhat marshy example having the following phanerogamic composition:

Cassiope tetragona[3]	vad
Salix herbacea	a
Ledum palustre var. *decumbens*	f-a
Rubus chamaemorus (rarely flowering)	f
Vaccinium vitis-idaea var. *minor*	f

[1] Several fleshy saprophytic Fungi also occurred, but were not identified.

[2] One area of marsh was noted in which the dominant *Carex rariflora* was only just coming into flower on August 20, 1936 This was evidently an anomaly (the snowfall having been unusually heavy that spring), whose continuation would probably lead to the disappearance of the species from this spot.

[3] Frequently parasitized by *Exobasidium vaccinii* var. *myrtilli*.

Alopecurus alpinus	o
Salix fullertonensis	o
Arctagrostis latifolia	r
Carex scirpoidea[1]	r
C. vaginata	r
Dryas integrifolia (apprg. f. *intermedia*)	r
Eriophorum callitrix	r
Poa arctica	r
Vaccinium uliginosum var. *alpinum*	r
Pedicularis hirsuta	vr
P. lapponica	(1)

In spite of the dampness of the soil, which had allowed the ecesis of several marsh species, the *Cassiope* was overwhelmingly dominant, covering about three-quarters of the area though rising only 8 to 11 cm. above the surface of the ground. Beneath, the soil was dark and humous to a depth of 12 cm. before the coarse sandy substratum was reached. Cryptogams were plentiful and mixed; they included an abundance of several different species of mosses as well as of brown Cetrariae and, in a damp depression, a close investment of *Gymnomitrium corrallioides,* the records for which from this place I unfortunately omitted from my account of the Hepaticae in Part II of the present series. The poorness of the flora is due in some measure to the luxuriance of the dominant *Cassiope;* where this was more interrupted and "patchy", various other associates were to be found.

(v) FRESHWATER

The freshwater habitats around Chesterfield were numerous and very variable. Small streams, besides having their beds frequently clothed with luxuriant felty mats or tassels of aquatic mosses, may where sluggish bear brownish or greenish deposits or floating masses that are rich in such Algae as the following (excluding Diatomeae):

Aphanocapsa pulchra
Chamaesiphon incrustans
Chroococcus turgidus
Closterium lanceolatum
**C. parvulum*
C. ralfsii var. *hybridum*
**Cosmarium biretum*
**C. botrytis*
**C. conspersum*
C. cucurbitinum
**C. granatum*
C. humile
C. impressulum
C. phaseolus
C. sexangulare
C. subcostatum
**C. subcrenatum*
**C. turpinii*
Euastrum ansatum
E. binale var. *gutwinskii*
E. pectinatum
E. verrucosum
Gloeocapsa punctata
Gloeothece confluens
**Gonatozygon monotaenium*
**Hyalotheca dissiliens*

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[1] Sometimes infected with *Cintractia caricis*.

* For explanation see next page.

Merismopedia punctata
**Oocystis naegelii*
Pediastrum boryanum
Penium margaritaceum
Peridinium cinctum
Pleurotaenium ehrenbergii
**P. truncatum*
**Scenedesmus obliquus*
**Staurastrum brebissonii*
S. dejectum
S. dickiei
S. dilatatum
S. subpygmaeum
Tolypothrix tenuis
Xanthidium antilopaeum

This is a considerable list, totalling forty-one species, obtained from three phials taken in the third week of August, 1936, and preserved in a fluid consisting principally of alcohol and glycerine; it does not include the diatoms, of which several forms were also common.

Similarly numerous and variable are the Algae of some tarns and peaty pools. From one or more of five samples of filamentous or mud-binding deposits or gelatinous colonies taken near the margins of such bodies of standing water toward the end of the third week of August, 1936, all of the forms marked ' * ' in the above list were identified, and, in addition, the following[1], the desmids and other small forms being enmeshed or enclosed in masses of filaments or gelatinous colonies:

Ankistrodesmus falcatus
Aphanocapsa rivularis
Aphanothece microscopica
Apiocystis brauniana
Calothrix fusca
Closterium dianae
C. didymotocum
C. rostratum
C. striolatum
Cosmarium arctoum
C. conspersum f. *minor*
C. crenatum
C. depressum var. *achondrum*
C. holmiense var. *integrum*
C. humile var. *striatum*
C. ochthodes
C. punctulatum
C. reniforme
C. undulatum var. *minutum*
Dichothrix gypsophila
Euastrum bidentatum
E. verrucosum var. *reductum*
Gloeocystis gigas
Lyngbya nana
Merismopedia tenuissima
Microcystis pulverea
Nostoc commune
N. kihlmani
Oocystis borgei
O. elliptica
Penium cylindrus
Schizothrix sp.[2]

[1] Here again, as in the remaining lists given below, the names of any diatoms are lacking, as those which I collected at Chesterfield have not been determined.
[2] Record omitted from Part II.

Sphaerella nivalis
Staurastrum apiculatum
S. controversum
S. muticum
S. polymorphum
S. punctulatum and var. *pygmaeum*
Stigonema informe
Tolypothrix lanata
T. limbata
Zygnema peliospermum

FUNGI *Ancylistes closterii* in "*Closterium intermedium*"
Olpidium utriculiforme in *Cosmarium conspersum* and *C. undulatum* var. *minutum*

Many other habitats around, even when very limited in area or restricted as to the amount and duration of the available moisture, were prolific in Algae. Thus from "on sheath of a colonial animal" Dr. Whelden identified all of the following (*See* Part II of the present series):

Aphanothece saxicola
Cosmarium granatum
C. hammeri
C. holmii
C. humile var. *glabrum*
C. isthmium
C. phaseolus
C. punctulatum
C. quadratum f. *willei*
C. regnesi
C. tinctum
Euastrum bidentatum
Merismopedia glauca
M. tenuissima
Oocystis gloeocystiformis
Pediastrum boryanum
Scenedesmus bijugus
Staurastrum brachiatum
S. dejectum
S. dickiei
S. furcatum
S. polymorphum
S. teliferum
S. tetracerum

Many of the above appeared to be absent from the phials collected in surrounding streams and lakes; truly the algal (particularly desmid) flora of the region must be enormous.

Colonizing shallow water around the margins of permanent tarns and lakes were to be found luxuriant beds of, particularly, *Carex aquatilis* agg., *Colpodium fulvum* var. *effusum, Eriophorum angustifolium, E. scheuchzeri, Ranunculus trichophyllus* var. *eradicatus*, and *Hippuris vulgaris*. Plate CVI shows a dense bed of the last-named pioneering where the bottom is muddy, succeeded by an equally dense bed of the beautiful *Eriophorum scheuchzeri*. Often, however, the bottoms of lakes were devoid of higher plants and even of macroscopic Algae.

In shallow pools and around lake margins where the level is likely to recede considerably in late summer, as is frequently the case especially in rocky places, *Ranunculus hyperboreus* var. *turquetilianus* and such mosses as *Campylium stellatum, Cinclidium subrotundum, Philonotis tomentella,* and *Splachnum vasculosum* frequently form luxuriant mats that higher up may support a sward of *Epilobium palustre, Koenigia islandica, Montia lamprosperma,* and *Stellaria crassifolia*.

PLATE CVI

Shallow water of muddy pool in sheltered situation colonized by dense bed of *Hippuris vulgaris* (on right), followed by a luxuriant band of *Eriophorum scheuchzeri* that is rapidly succeeded by consolidated mixed marsh (behind, on left). Chesterfield, W. Coast of Hudson Bay, Aug. 20, 1936.

PLATE CVII

Large caespite of *Carex physocarpa* surrounded by runners of *C. chordorrhiza* at lake margin. The muddy surface is darkened by a dried and cracking deposit of colonial Cyanophyceae. Behind is a poor, boulder-strewn marsh. Chesterfield, W. Coast of Hudson Bay, Aug. 19, 1936.

In the drying muddy bed of one small tarn whose water had entirely disappeared by the middle of August, 1936, I found, growing together in considerable abundance, three diminutive but characteristic aquatics that were all flowering and all hitherto unrecorded from the Canadian Eastern Arctic. They were *Callitriche verna* var. *minima*, *Eleocharis acicularis* (the sterile f. *submersa* was found elsewhere in our area during the same summer—*See* Part I, pp. 105-6), and *Ranunculus reptans.* Hereabouts were also *Deschampsia pumila*, *Carex bicolor*, and *C. holostoma*—and, at the margin where the water disappeared early in summer, characteristic long runners of *Carex chordorrhiza* or large caespites of *C. physocarpa*, the resulting community being frequently interspersed by more barren muddy areas whose surface was darkened by a dried and cracking deposit of colonial Cyanophyceae (*See* Plate CVII). Nevertheless one got the impression that algal pioneers were introducing ameliorating factors which favoured colonization by, and the ultimate luxuriance of, higher plants as in other parts of the world (cf. Polunin 1941b, p. 375, and MS.c). Behind such lake marginal communities there were usually developed marshes wherever local topography allowed; these were of varying types, including that listed above, and frequently remained so wet and boggy even in late August that one sank in them halfway to the knee, although below there was generally a rocky or stony bed, all these areas near the coast being evidently "young". Their emergence from the sea only in comparatively recent times is further evidenced by the slight brackishness of some of the lower-lying lakes—especially as indicated by their algal flora and the occurrence around their margins of such definitely "saltmarsh" types as *Carex bipartita* var. *amphigena*, *C. salina* apprg. var. *subspathacea*, *C. ursina*, *Chrysanthemum arcticum*, *Stellaria humifusa*, and even *Puccinellia phryganodes*.

(vi) SEASHORE AND LAGOON

Rocks and boulders between tide-marks (the tidal range at Chesterfield is considerable) supported at all points visited an abundance of *Fucus vesiculosus*[1] with associated smaller Algae—especially *Pylaiella littoralis*, which frequently grew as an epiphyte on the *Fucus* stipes. No larger laminarians were observed growing, although a few were to be found cast up on the beach in a fresh condition; however, tidal pools supported an abundance of small Algae, including the following:

Anabaena variabilis
Calothrix contarenii
Dichothrix rupicola
Enteromorpha intestinalis
Pylaiella littoralis
Tolypothrix lanata
Ulothrix flacca

These were mostly to be found quite far up near high tide-mark, where the water was at times only brackish and the *Fucus* was absent, and where the *Pylaiella* and *Ulothrix* also formed a greenish "felt", with associated large thalli of *Enteromorpha intestinalis*, e.g., on most subaerial rocky surfaces that were sufficiently sheltered from the sun and drying winds.

The sandy or gravelly beaches or occasional more extensive bars above high tide-mark supported plentiful *Elymus arenarius* var. *villosus* (apprg. var. *villosissimus*), *Arenaria peploides* var. *diffusa*, and *Mertensia maritima* var. *tenella*—much as in most other parts of Hudson Bay and Strait—as well as a

[1] Cf. footnote (1) on p. 29.

host of smaller colonists, including *Arabis arenicola* (apprg. var. *pubescens*), *Artemisia borealis, Carex maritima, Castilleja pallida, Matricaria inodora* var. *nana, Sagina intermedia,* and *Taraxacum lacerum.*[1]

A (presumably somewhat brackish) 'lagoon', whose water was yet quite drinkable, and which supported in abundance such Algae as *Chamaesiphon cylindricus, C. incrustans, Cladophora kuetzingiana, Cosmarium kjellmani, Cosmarium phaseolus, Pediastrum boryanum, Scenedesmus obliquus,* and sterile *Zygnema* spp., had around its margin a 'relict' saltmarsh community that was being invaded by (freshwater) hydrophytes, the following being the most typical phanerogams in this habitat:

Puccinellia phryganodes	vad
Dupontia fisheri	vad
Carex ursina	la
C. bipartita var. *amphigena*	
C. salina apprg. var. *subspathacea*	
Chrysanthemum arcticum	
Cochlearia officinalis var. *groenlandica*	
Deschampsia caespitosa var. *littoralis* (agg.)	
Epilobium palustre	
Eriophorum scheuchzeri	
Juncus arcticus	
Koenigia islandica	
Luzula spadicea	
Matricaria inodora var. *nana*	
Potentilla egedii	
Puccinellia paupercula	
Ranunculus hyperboreus	
Sagina intermedia	
Salix arctica (incl. apprg. var. *kophophylla*)	
Saxifraga caespitosa	
S. nivalis	
S. rivularis	
Stellaria crassifolia	
S. humifusa	

Near the edge of the water the stoloniferous *Puccinellia phryganodes* was overwhelmingly dominant, but here as elsewhere—and it was chiefly farther back that the less halophytic colonists had attained ecesis—the whole was woven into a close greenish brown mat by such mosses as *Calliergon giganteum, Campylium stellatum,* and *Leptobryum pyriforme.* This mat, within a few metres of the edge of the water, or as soon as a height above the latter of about 50 cm. had been attained, passed into one of the heathy or "barrens" communities of the general hinterland. A similarly rapid transition was noted on most rocky areas of the open coast, almost all halophytic species disappearing, even where there was soil or turf, as soon as the level of the highest tides had been exceeded by about 50 cm.

[1] Frequently parasitized by *Puccinia variabilis.*

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INDEX TO PLACE-NAMES[1]

[1] Exclusive of some regional designations and mere titles and addresses.

INDEX TO LATIN NAMES

CANADA

DEPARTMENT OF MINES AND RESOURCES

NATIONAL MUSEUM OF CANADA

BAFFIN BAY
DAVIS STRAIT
GRE
Baffin Island
DISTRICT OF FRANKLIN
NORTHWEST TERRITORIES
DISTRICT OF KEEWATIN
Foxe Basin
Foxe Channel
Hudson Strait
Ungava Bay
Devon Island
Jones Sound
Lancaster Sound
Bylot Island
Somerset Island
Brodeur Peninsula
Boothia Pen.
Gulf of Boothia
Melville Peninsula
Southampton Island
Cumberland Peninsula
Cumberland Sound
Hall Peninsula
Foxe Pen.
Melville Bay
Norwegian Bay
Prince Regent Inlet
Admiralty Inlet
Wellington Chan.
Committee Bay
Repulse Bay
Wager Bay
Chesterfield Inlet
Chesterfield
Roes Welcome
Frobisher Bay
Nettilling L.
Amadjuak L.
Arctic Circle
Upernivik
Svarton Huk Peninsula
Nugsuak Pen.
Disko I.
Disko Bay
Godhavn
Christianshaab
Holsteinborg
Sukkertoppen
Lake Harbour
Port Burwell
Wakeham Bay
C. Wolstenholme
Coats I.
Mansel I.
Salisbury Is.
Nottingham I.
Resolution I.
Pond Inlet
Dundas Harbour
Craig Harbour
Coburg I.
Philpots I.
Beechey I.
Cornwallis I.
Grinnell Pen.
Dundas I.
C. York
C. Shackleton
C. Dyer
C. Mercy
C. Chidley
Hebron
Okkak
Nachvak
Ramah
Saglek B.
Payne R.
Kovik
Kingwa
Marble I.
Rankin Inlet
Dawson Inlet
Hoppner Inlet
Rae Isthmus
Simpson Pen.
Pelly Bay
75°
70°
65°
60°

MAP 558A

CANADIAN EASTERN ARCTIC

Scale, $\frac{1}{6,336,000}$ or 1 Inch to 100 Miles

Miles

100 0 100 200 300